THE

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THE

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WIRELESS TELEGRAPHY.

So much has been written on wireless telegraphy that Mr. Preece must have found it hard to say anything new about it in his lecture at the Society of Arts on the 5th inst. What appears to be new in Mr. Preece's discourse, namely, his theory, we are inclined to think is not true. The working of his own system, which is at present in use between Lavernock and Flatholm, "is due," he says, "to the formation of electro-magnetic waves of induction. These waves as they rise and fall set up electro-magnetic disturbances in conductors in their neighbourhood." In reply to a question on the use of the long vertical wires in the Marconi system, Mr. Preece said that in the electro-magnetic system (his own) the lines of force were rings round the conductor, the wave front being horizontal and passing into space in a horizontal direction. The receiver must, therefore, be horizontal also in order that it may be cut by as many lines of force as possible. In the other case (Marconi's) the lines of force were electrostatic, and at right angles to the lines of electro-magnetic force and to the conductor. Therefore, to secure the greatest number of lines, the transmitting wire must be perpendicular, and the receiver also. It would appear from this that Mr. Preece considers that in the Marconi system the electrostatic lines of force from the transmitting wire, spread out into space far enough to affect the receiving wire. It is on this theory that he founds his opinion that the Hertzian waves travel in curved paths along curvilinear lines of force. But it is evident that electrostatic lines of force proceeding from the wire will go by the shortest possible path to the earth, as shown in M. Blondel's paper on the theory of wireless telegraphy, which we published last week. The real transmitters of the signals across space are the electro-magnetic waves generated by the electric oscillations in the wire and the dielectric in its immediate neighbourhood. These secondary waves travel in straight lines, like light waves, except that they may have a somewhat greater spreading power owing to their lower frequency.

The question of priority in the invention of wireless telegraphy has been revived by a letter written by Prof. Hughes in reply to inquiries on this subject by Mr. Fahie. From a copy of this letter sent to us by Prof. Hughes, we learn that he discovered in 1879 that the microphone was sensitive to electric disturbances produced by the extra current of an induction coil. He carried out numerous experiments on this subject from 1879 to 1886. With a telephone and microphone in circuit he was able to detect the electric disturbances at a distance of 500 yards from his transmitter. Prof. Hughes believed that these effects were due to electric waves, but these experiments were carried out prior to the date (1887-9) of Hertz's demonstrations, and Hughes found it impossible to convince scientific men at that time. He says "The President of the Royal Society, Mr. Spottiswoode,

together with two hon. secretaries, Prof. Huxley and Prof. G. Stokes, called on me on February 20th, 1880, to see my experiments on aerial transmission of signals. The experiments shown were most successful, and at first they seemed astonished at the results, but towards the close of three hours' experiments Prof. Stokes said that all the results could be explained by known electro-magnetic induction effects, and therefore he could not accept my view of actual aerial electric waves unknown up to that time, but thought I had quite enough original matter to form a paper on the subject to be read before the Royal Society." Prof. Hughes was so discouraged by this opinion of Prof. Stokes, that he actually refused to write a paper on the subject. Evidently Prof. Hughes has only his extreme deference to the opinions of honorary secretaries of the Royal Society to thank for losing the credit of being one of the pioneers in the development of signalling by electric waves. Henry, of course, discovered long before Hughes, that electric sparks transmitted disturbances through walls and floors to considerable distances. The advance made by Hughes, appears to have consisted in the discovery that the microphone (*i.e.*, the coherer) was a very sensitive detector of electric disturbances.

There have been several announcements lately that Marconi has discovered a means of making his signalling selective; but the means by which he effects this are as yet kept secret. A special correspondent writing to the *Standard* of the 8th inst. says that Marconi has succeeded in concentrating his electric rays for a distance of 3 miles by means of reflectors, but has found them ineffective beyond this distance. Mr. Marconi, he says, does not rely much on syntony, though the correspondent himself appears to believe in it. We are inclined to go with Marconi on this question. Syntony has been shown experimentally to be non-existent with an earth connected system such as Marconi uses. Prof. Lodge's system, which was not earth connected, and had very slight damping, is what is required for successful syntonic experiments. But where is Lodge's system? Why is he not signalling across the Channel, or to ships at sea? But after all syntony would be a very poor protection against the overhearing of messages, because the frequency of any receiver could be rapidly changed till the message was picked up.

Niagara Falls Pumping Machinery.—At the time the wheel-pit of the Niagara Falls Power Company was extended three chambers were excavated in the east wall. Each of these recesses is 14 feet high, 16 feet wide, and has a depth of 35 feet, the ceiling being of arch form. It is now announced that the Niagara Falls Waterworks Company will instal two 6,000,000-gallon water pumping engines in these chambers, the Niagara Falls Waterworks Company being one of the companies allied to the Niagara Falls Power Company. These water pumping engines have been ordered from Fraser & Chalmers, of Chicago, and will be of the Riedler pattern. They will be direct connected to Pelton water wheels, driven under a head of about 120 feet. The pumps will be so arranged that either side of either of them may be used, and thus three, six, nine, or twelve million gallons may be pumped into the mains daily, as the demands of the water consumers make necessary. The water will be taken from the Upper Niagara river and passed through a filtration plant before it goes to the pumps. The present pumping station of the company is located in the rear of the power house, and the removal of the steam plant will make it possible to instal more filters. The new engines are expected to be a source of considerable economy, as they will do away with the purchase of coal for fuel purposes, which is the main item of expense. At the time the International Niagara Commission was in session in London it was suggested that the great generators might be placed in underground chambers instead of in a power house, as at present located, and thus do away with the long shafts connecting the turbines and generators. The adoption of the chambers in the wheel-pit for the pumping engines may yet lead to a still more novel and equally substantial electrical installation at Niagara Falls. The new pumping installation will be completed in October. The Niagara Falls Power Company is putting down 12,000 feet of power cable conduit, extending from their central station to the new plant of the Union Carbide Company. This conduit is made of vitrified tile $3\frac{1}{4}$ inches interior diameter, laid 36 in a nest, and sheeted with cement. A small sewer tile is laid under the conduit tile for the purpose of drainage. This style of conduit is found most serviceable and is popular with the Power Company.

Galvanic Polarisation.—Hans Jahn has repeated and extended his previous investigations on the polarisation of a cell, and the energy requisite for the decomposition of the electrolyte (*Zeit. Physikal. Chem.*, 1898, 18, 399—425); the present values are regarded as more accurate than those previously given; this is due, chiefly, to the use of a large ice calorimeter, which renders possible more accurate measurements of the thermal changes. The values obtained are given in the accompanying table, where p_0, p_{40} are the polarisations in volts at 0° and 40°; dp/dt is the temperature coefficient of the polarisation; ω, the energy in calories necessary for the decomposition of a milligram-equivalent of the electrolyte at 20°; ω_k and ω_a the heat developments at the cathode and anode respectively, calculated as indicated in the previous paper.

Salt.	p_0	p_{40}	dp/dt	ω	ω_k	ω_a
$CuSO_4$ ...	1·57	1·43	−0·0038	67·77	−10 07	+21·84
$ZnSO_4$ ...	2 62	2·48	−0·0035	115·98	−10·17	+20·06
$CdSO_4$ ...	2·33	2·18	−0·0038	102 34	− 8·77	+21·13
$Cu(NO_3)_2$ ...	1·56	1·42	−0·0035	67 77	−10·07	+25·43
$Pb(NO_3)_2$ ..	2·03	1·89	−0·0035	89·15	− 2·43	+23·51
$Ag(NO_3)_2$ ...	1·10	0 99	−0 0028	47 30	+ 2·53	+28 17

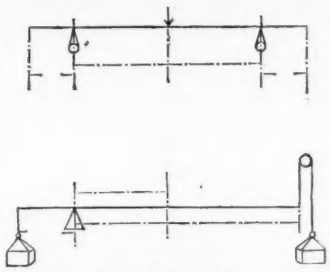
It is seen that, except in the case of silver nitrate, the temperature coefficient and anodic heat are practically identical for all the salts. If the values for the cathodic polarisation be subtracted from the above polarisation values, the resulting anodic polarisations are found to be identical, within experimental error, for all the salts examined, a result which is also theoretically deduced for the salts of all strong acids; for weak acids, however, smaller values should obtain. The investigations were extended to oxy-acids, and by the thermodynamical equations deduced by the author and Schönrock (*Zeit. Physikal. Chem.*, 1895, 16, 45—71), the value of the polarisation E.M.F. is calculated for sulphuric acid, and from this the loss of heat of the battery; the values obtained agree completely with the direct determinations. If, in the electrolysis of normal sulphuric acid, an anode of electrolytically deposited copper be employed, the total loss of heat should be equal to the difference between that due to the acid and that due to the copper sulphate, and this also was experimentally verified. According to the previous theoretical investigations, the polarisation is independent of the dissociation if the current is weak, and it was found to be so for the polarisation in phosphoric acid. The polarisation, however, being dependent on the occlusion of gas by the electrode, should vary with different electrodes, and the author found that, by the use of a mercury cathode, the polarisation in sulphuric acid reached 2·95 volts, the loss of heat being 50 per cent. greater than with the platinum cathode. In the case of the alkali salts, the polarisation should be equal for those salts, the hydroxides of which are equally dissociated, and this was verified by determinations of the polarisation in solutions of sodium and lithium sulphates; ammonium sulphate, however, owing to the more feeble dissociation of the hydroxide, gave a much smaller value. The above is an abstract of a paper by Hans Jahn in the *Zeit. Physikal. Chem.*, 1898, 26, 385—429.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 713.)

The keeping of the truss low possesses the further advantage of providing for the fifth desideratum mentioned above in a way that is impracticable with form fig. 21, where the truss is kept above the level of the tops of the pedestals, and the clearance below the car body reduced to a minimum. The rigid wheel base can, however, be equally reduced in both, so that desideratum 3 can be attained by either. The method of supporting the bolster frame on a swinging frame



Figs. 23 and 24.

slung fore and aft by four suspension links from the truck frame, in the case of fig. 21, admits of the longitudinal motion of the load independently of the truck, and introduces strains of unequal, and, therefore, dangerous character, due to the shifting of the relative position of load and points of support in the framework, especially when stops occur or sharp curves are entered at high speeds. This longitudinal shifting in fig. 22 is impossible, while, on the other hand, the suspending of the bolster transversely by links, as shown in fig. 22, tends to equalise the proportion of weight carried by the outer and the inner journals

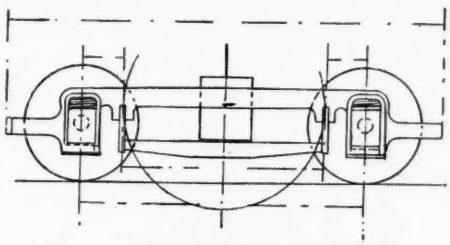


Fig. 25.

when working round curves at high speeds, the outer end of the bolster tending to rise higher the sharper the curve and the quicker the speed, and thus counterbalance the centrifugal excess which would otherwise be generated. The fact of the truck delineated in fig. 22 affording a more efficient

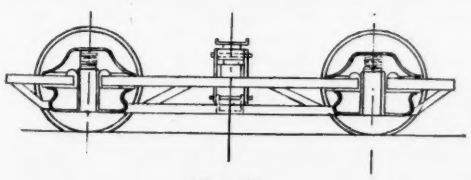
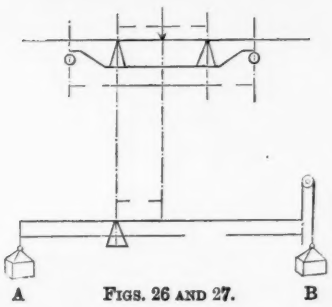


Fig. 25a.

support for the brake rigging, as previously pointed out, ensures that condition six is more certainly attained in this truck than in the other, so that on the whole the truck delineated in fig. 22 is superior to that delineated in fig. 21 in four out of seven respects, and equal in the other three.

Actual experience in the use of these improved bogie trucks has shown that they possess decided advantages over the ordinary swing beam equalised railway bogie truck, which was itself the result of long and careful experimental improvement. The electric traction bogie has proved itself superior to the railway bogie in easy riding on straights, in freedom from swing on curves, and in general exemption from liability to leaving the track, notwithstanding that the wheels used therewith possess far shallower flanges and narrower treads than those used with the railway bogie. The electric bogie has also proved itself steadier under the application of the brakes, the ordinary kicking up or lifting of one end and dropping of the other, with the clattering of brake blocks and uncomfortable jerking when suddenly stopped, has almost been done away with.

The explanation of this superiority is of scientific interest, and withal extremely simple, as will be seen from the following diagrams: figs. 23 and 24 apply to both the Brill and the Peckham bogie trucks, which are shown in outline in



Figs. 26 and 27.

figs. 25 and 25a, while figs. 26, 27, and 28 apply to the ordinary standard bogie truck for railways. The load sustained by the bolster in both cases rests on the centre of a swinging frame suspended from the truck framing by four links, and is applied to the journals through the intermediary of springs. In the case of the electric bogies these springs are placed vertically over the central axis of the journals, or immediately on each side of the same, so that the rise and fall of the journals interposes no leverage between them and the springs supporting the load (figs. 23, 25, and 25a); but in the case of the railway bogie the springs are fixed half way between the journals and the load, so that the springs carry the load at the outer end of a lever which is free to rise and fall with the slightest motion of the journals and throw very large unequal stresses on the springs, relieving one journal of a large proportion of the load and accumulating it on other, and *vice versâ*. This momentarily releases one pair of wheels from the downward pressure of the load

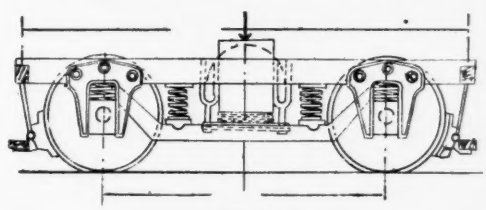


Fig. 28.

and leaves them free to obey any side impulse tending to throw them off the track, so that derailment at joints, points, and crossings, and round curves when the road is not in perfect fettle, is enormously facilitated in this form of bogie (fig. 28) as compared with the electric traction bogie.

Figs. 24 and 27 show the leverage to which the two types of truck are subjected under the action of the brakes. The weights A and B represent the respective forces exerted by the brake at the two extremities of the truck, A being the downward, and B (shown acting over a pulley) the upward thrust. When the motion is from B to A (see fig. 24), the downward pull of the leading brake blocks (in trucks 25 and 25a) has a leverage of 24 inches against 42 inches for the downward pull of the load, or 7 to 4 against tilting, while at the other end the upward lift of the brake blocks has a leverage of 108 inches against 42 inches for the downward pull of the load, or 18 to 7 in favour of tilting, the result of the difference of the two leverages being against the downward pull of the

load (in the proportion of 11 to 7), but as the pull of the load is always vastly in excess of the push of the brake blocks, the stability of the truck is only slightly less under the influence of brakes than when the brakes are not applied at all.

In fig. 26, however, the downward pull of the leading brake blocks has a leverage of 45 inches against 21 inches for that of the load, or 15 to 7 in favour of tilting. While

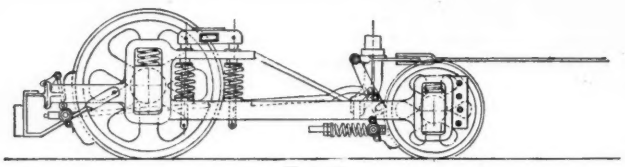


Fig. 29.

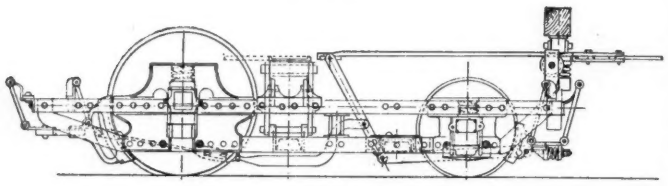


Fig. 30.

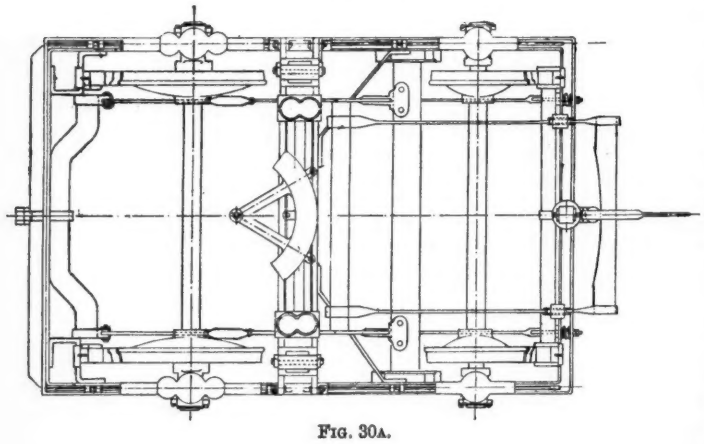


Fig. 30A.

at the other end the relative leverages are as 87 inches to 21 inches, or as 29 to 7 in favour of tilting, the result being a general leverage in favour of tilting against the load of 44 to 7 which materially reduces the disparity between the pull of the load and the push of the brake blocks, and dangerously reduces the stablility of the truck.

The conclusion to be drawn from the above is, that the peculiarities in the construction of the electric bogie trucks renders them far more adaptable to the case where brakes

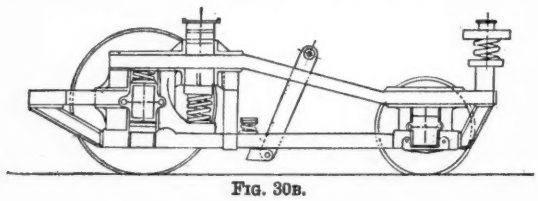


Fig. 30B.

are applied utilising momentum or air power instead of hand power than the railway types, and therefore more suitable for the requirements of electric traction.

Owing to the fact that there is practically no tilting of the truck frame, there is no displacement of the centre of gravity of the load carried, and consequently the only difference in weight brought upon the two sets of wheels by the act of stopping is that due to the horizontal component of momentum, and this for the same load is the same in all trucks. The steadiness of the truck, and the fact of the brake blocks retaining their normal position during the stops, makes accuracy in adjustment of the blocks less essential. Practically, the brake shoes are always applied to the wheels in the same place, and there is, therefore, no occasion for the front block to be drawn down or the rear block to be lifted up unduly above its normal position.

There is a form of truck still to be described, which is coming more and more into use for motor cars, and which presents many advantages over the ordinary form of four-wheel bogie truck which has already been considered. This has received the name of the Maximum Traction truck; its chief peculiarity consists in placing as much as possible of the load (car and motor) over one pair of wheels (the drivers) which are of larger diameter than the other pair (the idlers), and thus increase the proportion of useful adhesion for tractive and braking purposes, and do away with the necessity of four motors. Both the Brill and Peckham Companies manufacture trucks of this character, the Brill Company having been first in the field, but there are several important points in which their trucks differ, and these are well worth consideration. The designed disproportion between the weights carried by the drivers and the idlers in the maximum traction truck would be immaterial were it practicable to always run with the idlers leading, as under this condition of running, no matter how small the proportion of the whole load carried by the idlers might be, so long as it was sufficient when united to the weight of the wheels and axles and that end of the truck, to knock any ordinary accidental obstructions which might be present on the track out of the way, the idlers, under the application of the brakes, would have no tendency whatever to jump off. With present appliances and under existing running conitions on electric roads this is an impossibility. The usual arrangement is to make the idlers on the respective trucks face each other, so that whichever way the car may be running, one set of idlers will lead and one set of drivers follow, and *vice versâ*. In the set of idlers which follow, the proportion of the weight carried may be easily reduced so as to be less than the tendency to lift developed by the application of the brakes, and then the idlers would unavoidably jump off the track, without some special provision is made to counteract this tendency.

In these trucks, with the object of concentrating the major proportion of the load on the drivers, the car body is supported as close to the axis of the driver axles as the details of the design of the truck will permit, while to counteract the tendency of the idlers to jump the track when the drivers lead, an additional support for the car body is fixed close to the idler axles. This additional support only comes into play when the idler wheels commence to lift, and the lifting tendency is at once checked by the transference of an additional proportion of the load from the drivers to the idlers. This transference varies in proportion to the amount of the lift, the limit being the bringing about of an equality of load between the two sets of wheels. In this way the amount of lift can, in any case, be kept well under the depth of the flanges, and the tendency to derailment practically neutralised. It ought to be noted, however, that whenever the brakes are applied with the driving wheels of a maximum traction truck leading, and the additional support of the car body is brought into play, the truck in question, for practical purposes, ceases for the time being to be a maximum traction truck, as the drivers no longer carry the designed excess of load increasing their useful adhesion. To do away with the above defects of a maximum traction truck under existing running conditions, the author would suggest the advisability of using small turntables at the dead ends of tramway lines, on which the trucks could be individually turned by the motor men without interfering with the cars, previous to reversing the direction of the journey.

In both types of truck under consideration (figs. 29, 30, 30A, and 30B) all the supports are spring cushioned, as is the case with the other forms of trucks previously considered.

In the type given in fig. 29, the car body is supported, under normal conditions, by two radial flanged plates

forming a socket, between the sides of which a corresponding projection in the underframe of the car body is retained, this socket fulfils the functions of a "King" pin, which this type of truck does not possess. The surface of these socketed swivelling plates is considerable and unavoidably no protection can be afforded to them against dust and grit, so that lubrication is a constant source of trouble.

The centre of the swivelling socket is 12 inches from the axis of the driving axle, so that with a wheel base of 4 feet 6 inches, the drivers carry $\frac{7}{9}$ths (78 per cent.) of the load and the idlers $\frac{2}{9}$ths (22 per cent). The motor is suspended half-way between the two axles so that half the weight is carried by each axle. Taking the whole load (car plus motor) in accordance with ordinary home practice as being 6 plus 1 tons, distributed as above, the effective weight on the drivers would be $2\frac{5}{9}$th tons and on the idlers $1\frac{1}{9}$th tons, so that the former actually carry 71 per cent. and the latter 29 per cent. of the total load. This proportion is evidently excessive when the trucks are running with drivers leading and entails the frequent calling into play of the additional support, *i.e.*, the transference of load from driving to idler wheels and the addition of new frictional area to the normally excessive frictional area of the swivelling socket.

It should be noted also that the omission of a definite swivelling centre in this type of truck must produce most undesirable strains on the car body, which is, therefore, quickly weakened and knocked to pieces.

In the type given in fig. 30, the only essential difference lies in the substitution of a "King" pin for a swivelling socket, which arrangement does away with the undesirable strains in the car body, and also reduces the surface of the frictional area affording normal support to the car body. The other differences are similar in character to those detailed in the consideration of the bogie trucks of the respective companies in question.

Figs. 30A and 30B are an elevation and plan of a maximum traction truck which is designed from a different point of view to the foregoing. The bolster supporting the car body is located further from the axis of the driving axles (18 inches) so as to make room for its support by four links transversely, which equalise the weight on the journals, as described in the bogie truck, when going round curves, and keeps the centre of gravity low; but the supporting bolster carries a segmental swivelling plate, at the further end of which is the "King" pin, usually only 6 inches away from the axis of the driving axles, but capable of adjustment to any desirable interval.

The importance of bringing the swivelling centre of the car body as close as possible to the axis of the driving axle is obvious, as upon this distance depends the space the driving wheels occupy between the car sills when the body swings, and hence with the height of the sills above rail level constant, places a practical limit on the diameter of the driving wheels. Except when the car body is actually swinging round its centre of support, the rubbing surfaces of this form of swivelling plate are always protected from dust and grit; they are self-lubricated from an oil well in the under plate, and the wear and tear and maintenance is thus reduced to a minimum.

To relieve the "King" pin from shearing strains and consequent grooving or rupture, the plates are socketed into each other, so that when in position the car body could be swung, even if the "King" pin were entirely removed. The motors in this type of truck can be carried outside the driving axle and supported on the cantilever extension truss. By this method of carrying the motors the load can be so

TABLE VII.—CANTILEVER EXTENSION TYPES.

Weight complete	Description.	Wheel base.	Spring base.	Car truss.	Limiting length of body.		Remarks.
					Closed.	Open.	
	Single Trucks.						
	VARIETY A.—High Speed Single Trucks.						
lbs.							
4,400	Standard, 8A	6 ft. 8 in.	13 ft. 4 in.	To suit body	18 to 20.	28 to 30.	For high speeds and double-decked cars.
4,800	Extra long, 9A	"	14 ft. 6 in.	"	20 to 22.	28 to 32.	
5,200	Metropolitan Special, 10	"	"	"	20 to 24.	30 to 35.	Extra long and extra heavy.
	VARIETY B.—Moderate Speed Single Trucks.						
4,200	Excelsior, 7B	6 ft. 8 in.	13 ft.	To suit body	16 to 18.	24 to 26.	For ordinary speeds and single-decked cars.
4,300	Excelsior, 7D	"	16 ft.	"	Short or extra long.		
4,700	Extra long, 7D	"	16 ft.	"	Extra heavy.		Cincinnati special.
	Cantilever bogie types.						
	VARIETY C.—Centre bearing flexible bolster, long wheel base; City and Suburban services.						
3,800	No. 14	5 ft. 6 in. to 7 ft.	...	...	28 to 35	double motors	Moderate speeds.
4,500	No. 14	"	...	...	45		Extra strong.
	VARIETY C'.—Centre bearing swing bolster.						
4,200	No. 14A	5 ft. 6 in. to 7 ft.	...	...	28 to 35	double motors	High speeds.
5,000	No. 14A	"	...	...	45		Extra strong.
	VARIETY D.—Short Wheel Base; City and Suburban Trucks.						
4,200	No. 14B	4 ft. to 4 ft. 6 in.	...	...	28 to 35		Single motor, 70 per cent. of load on drivers.
4,200	No. 14B	"	...	...	"		For two motors.
	Maximum traction types.						
	VARIETY E.—Short Wheel Base; Urban Service.						
3,600	Middlesboro special ...	4 ft. 6 in. to 5 ft. 6 in	...	...	28 to 35		Single motor, 80 per cent. of load on drivers.
3,400	Swing bolster, 14 D2 ..	"	...	...	"		Single motor.
4,200	Extra strong, 14 D3 ...	"	...	...	"		Double motors.
	Locomotive types.						
	VARIETY F.—Single Trucks; Mining Service.						
4,800	No. 16	6 ft. to 7 ft.	...	...	...		Cantilever ends stiffened by suspension as well as strutting members. Single or double motors.
	VARIETY G.—Double Trucks; Heavy Locomotive Service.						
7,000	No. 17	6 ft. to 7 ft.	...	...	...		Extra heavy, weighing, with two G.E. 57 motors, about 12,000 lbs. per truck.

distributed that as much as 90 per cent. of the total can if desired be concentrated on the driving axles, and 10 per cent. only relegated to the idlers.

The proportion of the area of rubbing surfaces of the segmental plates and the "King" pin to that of the swivelling sockets described in the previous type, is entirely in favour of the present type; and no undesigned and undesirable strains are induced in the car body when swinging.

The stability of these trucks running with the idlers in front under the application of the brakes is remarkable, the leverage being almost wholly in favour of the load. In a truck of the same wheel base as that given in fig. 25A, leaving the motor out of consideration, the leverage (with 20-inch idlers and 33-inch drivers) in favour of the downward pull of the brake blocks would be 18 inches, against 66 inches for the downward pull of the load, or as 11 to 3 against tilting, while at the driving end the upward lift of the brake blocks has a leverage of 108 inches against 66 inches for the downward pull of the load, or 18 to 11 in favour of tilting, equal barely $1\frac{3}{4}$ in favour of the brake lift as against the downward push of the load, the general leverage against tilting being as 11 to $10\frac{1}{2}$ in favour of the load.

The brake rigging is of the upright lever type, the pressure on the idler wheels being reduced in proportion to the reduced weight they carry by pulling against a spring back of the pilot brake beam instead of pulling directly against the beam itself, the pressure on the pilot blocks being limited to that given by the compression of the spring. The upright levers are carried on a centre beam next to the bolster. The attachments of the rods connecting the floaters to the bar at the centre of the car are brought so near the centre of swing that there is no need for compensation for said swing.

The advantages of the maximum bearing traction trucks of this type can be summarised as follows:—

1. The centre bearing "swing bolster" relieves the car body, the wheels, flanges and track from all strains due to rigid side bearings, and removes all tendency in idlers to leave the track.

2. By the suspension of the motors outside of car body and close over the driving axle, a larger percentage of load on the driving axle is obtained than by any other arrangement without risk of derailment.

3. The overhanging pivot bearing of the car body reduces the swing of driving wheels between sills to a minimum, allowing the use of narrower cars and relatively bigger driving wheels.

4. The arrangement of the springs is such that two complete sets are interposed between the car body and the axles.

5. The brake connections are so constructed as to differentiate the brake pressure on wheels in proportion to the weight carried.

6. The distribution of the load is such that no special arrangement of springs is necessary for idler wheels to keep them on the track, and the effective load on drivers for traction is increased some 10 per cent. over most other forms.

7. The brakes are constructed on the gravity principle without links, pull-back springs or other movable parts on the spring attachment over small wheels, all noise is done away with, the wearing parts are reduced from 24 to 4 in the brake rigging, and thus maintenance is reduced to a minimum.

As an example of the way in which the fundamental ideas underlying the type of truck selected by the Peckham Company have been preserved while the details have been modified to meet all the varied requirements of electric traction, the table of the standard trucks manufactured by that company is appended. (See page 757.)

(To be continued.)

THE ROYAL SOCIETY CONVERSAZIONE.

The show of apparatus at the first conversazione of the Royal Society on the 3rd inst. contained many things of considerable interest to the electrical fraternity. Though most of us have already heard a good deal about some of the exhibits, still the most of these inventions have first seen the light of day within the past year; and physical science has no reason to be ashamed of its 12 months' output.

The influence machine exhibited by Mr. W. R. Pidgeon marks an advance in the right direction. The loss by leakage from all influence machines hitherto in use is enormous, and Mr. Pidgeon's improvements have been successfully directed to the reduction of this loss. His tinfoil sectors and inductors are mounted on glass or vulcanite in the usual way, but they are also covered over with a layer of rosin and paraffin wax, to prevent leakage from the edges. The machine, in its design, is a combination of the rotating plate and fixed inductor type. It starts very readily, is very little affected by moisture or dust, and requires no enclosing case. The output is from 4 to 6 times that of similar machines with uncoated plates.

A Wehnelt interrupter, of German make, was exhibited by Mr. A. A. Campbell Swinton. The novelty about this form of the instrument consists in a screw adjustment for the platinum wire, by which a greater or less length of the wire can be exposed to the acid. The platinum wire slides in a porcelain tube passing through the side of the glass container to the point where the platinum wire is connected to the adjusting screw. This arrangement forms a very convenient means of regulating the amount of current supplied to the coil. Mr. Swinton showed some pretty experiments with his Wehnelt break coil; the repulsion of an aluminium ring by an electro-magnet; the passage of a current through a slightly heated glass rod; and rotating mirror experiments to show that the frequency of the interrupter could be varied within wide limits.

Microscopic specimens showing the effects of strain in metals were exhibited by Prof. Ewing and Mr. W. Rosenhain. These specimens showed that when metals are strained beyond the elastic limit, plastic yielding takes place by numerous slips occurring on cleavage or gliding planes within each of the crystalline grains, as explained by the exhibitors in a paper read before the Royal Society on March 16th. These slips are shown by dark lines or bands appearing on the face of a polished specimen when it is extended or compressed, or otherwise strained.

Mr. Shelford Bidwell has already made many interesting discoveries in connection with the optical properties of the eye. His exhibit this year explains how it is that a bright object when out of focus on the retina is not merely blurred but shows a large number of distinct images. An incandescent electric lamp filament, seen through a lens from a distance of a few feet gives as many as 400 images. Bidwell has demonstrated that the effect is due to the diaphragm action of the cellular structure of the transparent media of the eye, and may be imitated by means of a lens covered with a few layers of gauze.

Nernst electric lamps were exhibited by Mr. James Swinburne. These lamps appear now to have received their final form, though they are not yet on the market. The 20-candle lamp looks externally exactly like an ordinary carbon filament lamp; the translucent bulb, however, is only used to soften and diffuse the light. The refractory pencil is about $\frac{3}{4}$-inch in length and about the thickness of the lead of a pencil. It is attached at its ends to two platinum wires and is surrounded by a small cage of platinum wire which effects the preliminary heating. It is claimed that this lamp gives 1 C.P. per $1\frac{1}{2}$ watts with a life of 500 hours; at 2 watts per candle the life is said to be eternal. A small solenoid in the socket of the lamp cuts out the platinum heater when the lamp is lighted. The lamp is made to fit on the present fittings. The lamp gives a very steady white light. Granting all that is claimed for this lamp, the first cost, with so much platinum wire in its structure, must be considerable.

A Michelson echelon grating spectroscope, made for Lord Blythswood by Mr. Hilger, was exhibited by the latter. This new arrangement has a resolving power of 118,000; and can be made at considerably less cost, and is more luminous than diffraction gratings of corresponding power.

One of the most interesting exhibits was Prof. Hele Shaw and Mr. A. Hay's of the application of stream lines to determine experimentally the distribution of magnetic lines of force in fields containing paramagnetic or diamagnetic bodies. Prof. Hele Shaw has been working for some years back at these stream lines, and has applied his method to the problems of Naval architecture. His method is to

cause a fluid, preferably glycerine, to flow in a thin sheet between two transparent plates, and show the stream lines by bands of colour at equal intervals. When a partial obstruction is introduced, say, half the thickness of the sheet of liquid, the stream lines show the effect produced by a diamagnetic body in a magnetic field. When a recess is made in one of the plates so as to widen the channel, the stream lines show the effect produced by placing a paramagnetic body such as iron in the magnetic field. Problems that have defied mathematical treatment have already been solved by Prof. Hele Shaw's experimental method.

Mr. Duddell's beautiful oscillograph, Prof. Callender's meters, and a new thermo-electric combination of constant E.M.F. by Prof. W. F. Barrett, each received all the attention they deserved.

Sir W. Crookes exhibited the apparatus by means of which he had succeeded in isolating a new element, victorium, after a Herculean labour of 25 years. The plan adopted was to incandesce the material by cathode rays, take the spectroscopic image, till by continued fractionation a permanent spectrum of a few lines was reached.

THE NATIONAL TELEPHONE COMPANY'S STAFF DINNER.

The annual staff dinner of the National Telephone Company, which was held at the Trocadero Restaurant last Friday evening, was as successful as these gatherings usually are.

The Chairman, in proposing the toast of "The National Telephone Company," said that the past year had been one of unprecedented activity and prosperity for the undertaking. During the 12 months they had added over 15,000 subscribers to their list, as compared with 12,000 in the preceding year, and they had opened in different parts of the country no fewer than 87 new exchanges. They were now sending 542,000,000 messages per annum, whereas the number of telegrams sent by the Post Office Department was 83,000,000. Out of the company's 874 exchanges in this country they had succeeded in placing 692 largely underground on the twin-wire principle. In other words, nearly 80 per cent. of their plant to-day was of the most modern description. They were threatened with competition, but he did not believe that anything of the kind would work in connection with the telephone service. It might go on for a time, but it was not possible as a principle. A great change had taken place since they last met in what he might call the political aspect of the telephone question. The Government had made up its mind to a new departure. On the morning following the last debate on the matter in the House of Commons, the *Times* gave them this advice: "Don't whine." Well, they would not. Whatever the new situation might be, they would face it like men, but they had the right to ask for equality of treatment with competitors. If they were given that he believed the company, with its loyal and highly-trained staff, would have no reason to fear the result.

Lord Harris, in responding, said it was remarkable that the public should support the service to the extent they did in face of the condemnation that had been passed upon the service. He thought that showed conclusively there was some merit in it. By degrees Parliament was being educated in the intricacies of the delicate service which was of so much use to the public. The company was entitled to fair treatment from the authorities, and that he thought it would get when Parliament thoroughly understood the case.

Sir J. Fergusson, M.P., said he was proud to belong to a company that conferred a distinct benefit upon the public. When he formerly made the agreement with the company on behalf of the Post Office he confessed he did not anticipate the interpretation that had been placed upon it by those who succeeded him. He regretted that accusations should be made that were ill-founded. It was extraordinary, for example, that a Minister representing a Department should fix the number of telephone lines at rather less than 50 per cent. of the actual number. He denied that undue preference had been given to anybody by the company. He expressed a hope that the terms which had been mentioned as those under which the company was to be treated would not be realised. He paid a high compliment to the efficiency of the staff, remarking that if they were justly dealt with they would be able to meet any competition.

The toast of "The Guests" was proposed by Mr. W. A. Valentine and replied to by Sir Albert K. Rollit. "Electrical Science" was proposed by Mr. D. Sinclair and responded to by Prof. D. Hughes.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Capacity Testing.

At the meeting on Thursday, April 27th, 1899, a paper by Mr. J. Elton Young on "Capacity Measurements of Long Submarine Cables," was down for discussion. In the absence of the writer, Mr. Murphy gave an abstract of the contents and described the modification of Gott's test which he had suggested to Mr. Elton Young, and which was the leading matter in the paper. It is to be regretted that the paper received such scant attention from the members of the Institution, for as Mr. Charles Bright remarked in the discussion, telegraphic papers are extremely rare, and we might add are likely to continue as rare in the future unless they are better appreciated when one does put in an appearance.

Unfortunately, we must admit that Mr. Murphy did not add to the interest such a subject was likely to evoke, as his treatment of the methods of capacity testing, however well suited to an audience solely composed of telegraphic experts, was anything but encouraging to the so-called heavy electrical engineer whose ideas of capacity testing are limited to an academic acquaintance with Kempe's standard treatise. This was made painfully manifest by the rapid thinning of the audience and the distraught expression on the faces of most of those who remained to the end of the meeting.

Mr. Murphy feelingly alluded to his early experience in capacity tests of cables when he dispaired of even hoping to ever attain the qualities requisite to the well-being of a cable electrician. He reminded those who were not so well versed in such questions as he is, that any result almost could be obtained by varying the method of test. He briefly ran through the different methods employed, and gave the explanation why Gott's method is usually adopted, that it is less affected by battery leaks than most of the others, but, on the other hand, leakage through the dielectric during the charging period requires the slider on, say, Kelvin-Varley slides to be continually moved towards the earthed end of the slides, and the apparent ratio of capacities differs from the true ratio due to the conductivity of the dielectric. He had suggested to Mr. Elton Young that the test might be modified by shunting the capacities with resistances, or, as we should prefer to describe the connections, by taking an ordinary Wheatstone bridge and placing the capacities across two of the arms usually designated as R and X respectively.

Mr. Alex. Siemens followed by discussing the formula given by Dr. Hopkinson, in which there are three terms: instantaneous capacity, residual charge or absorption, and conductivity of dielectric. He thought the subject might be taken in hand by young students, who should try to separate the elements of capacity. Departing somewhat from the subject of the paper, he pointed out that the K R law required modification, as K was not a definite quantity, as it is assumed to be. He likened the "soakage" element of capacity to the effect of lining a pipe for water transmission with a spongy material, and went on at some length to discuss the question of cable speeds and the improved results Messrs. Siemens Bros. had obtained by paying special attention to the "soakage" element of capacity.

The discussion at this point was adjourned until the 4th inst., when Mr. Charles Bright began his contribution to the discussion by debating the points raised by Mr. Siemens regarding cable speeds—a matter, as the chairman, Dr. S. P. Thompson, pointed out, not germane to, or, at least, not directly connected with, the paper. Proceeding to Mr. Young's paper, Mr. Bright said that the great point was its

conciseness. He thought many people did not realise the importance of really accurate capacity tests of submarine cables in such cases as where the sealed end of a cable was covered with a film of gutta-percha. Any results might be obtained if retardation was omitted. Balancing leakage and absorption by the method suggested was extremely satisfactory; this point he thought had been made clear. Here the chairman intervened and cut short the remarks Mr. Bright evidently intended to make on the subject of the paper, a summary proceeding Mr. Bright vigorously protested against.

Mr. Taylor pointed out that the capacity as measured by eliminating two factors from the Hopkinson equation was not the working capacity, and the value of K R based on instantaneous capacity is not the true one, being too high. In some experiments on cables of the Eastern Telegraph Company he found that mechanical inertia and the stiffness of fibre suspension and opposing E.M.F. in the coil of the receiving instrument limited the speed, and present instruments do not respond to the frequent impulses on short cables. Calculations on a common constant are therefore necessarily misleading. Mr. Smith rose to refute Mr. Siemens's statements as to speed, but was practically suppressed by the chairman. Mr. Murphy then briefly replied, citing some experience as to the speeds of cables and peculiarities in connection with the Siemens' loss of charge capacity test. Dr. Thompson acknowledged that to Mr. Oliver Heaviside is due the suggestion that we cannot ignore the effect on speed of the self-induction of the copper core of a cable; the whole subject now is regarded in the same way as an alternating current problem.

Mr. P. V. McMahon then read his paper on "Electrical Locomotives" as far as time permitted, illustrating his subject by slides.

CORRESPONDENCE.

Victoria Accumulator.

Referring to the criticism which appeared in your last week's issue by "A Contributor," upon the subject of our patent accumulator, we shall be greatly obliged if you will kindly insert in your next issue the letter which we send you herewith, and which is a complete reply thereto.

The discharges of the cells "D" and "B" were not uniform because the cell "B" was hurriedly despatched for the Paris test on March 3rd last without being completely formed, and it was explained that this particular cell was only required for testing the solidity of the paste under exceptionally heavy discharges.

The cell "B" was subjected to a discharge described in your issue of the 14th ult., as your contributor will see, which was abnormal for its size and weight. That trial was made on March 7th in Paris. Since then the same cell has been brought to Halifax without liquid, and at its next discharge on March 20th, gave a capacity of 165 ampere-hours at a discharge rate of 40 amperes. We claim that the Victoria accumulator is the only one which could have stood such an extreme test without being totally destroyed. Naturally the capacity of the cell, subjected to such an exceptional test as that on March 7th, would be lower than the capacity of a cell which had been completely formed and which was never subjected to abnormal discharges.

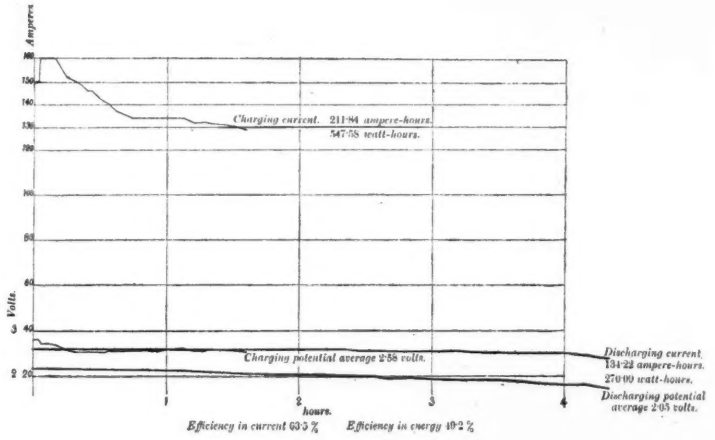
Regarding the efficiency, we give below an extract of a report made by Mr. Sappey in December, 1897, in London :—

Experiments No. 3.—The charge at the rate of 35 amperes was made on December 19th, 1897, and 176·045 ampere-hours were put in, equal to 439·82 watt-hours. A discharge made the following day at the rate of 13·6 amperes gave 164·12 ampere-hours, or 338·83 watt-hours. The energy efficiency was 77·05 per cent., and the current efficiency 93·22 per cent.

Experiment No. 4.—The cell was charged at the same rate, and 167·3 ampere-hours put in, equal to 391·19 watt-hours. On discharging this cell at the rate of 52·5 amperes it gave 147·807 ampere-hours, or 297·76 watt-hours. The current efficiency was 83·31 per cent., and the energy efficiency 76·11 per cent.

Further, he says that, "a discharge of 8·15 (this should read 3·15) amperes per kilo. of plate the energy efficiency dropped suddenly to 50 per cent.

Our omission to state the rate of charge was apt to lead your contributor to a wrong conclusion.



We enclose herewith a diagram of the charge and discharge of this cell. The figures will show that at such a high rate of charge the efficiency must fall considerably.

As to the comparison with the Fulmen accumulator, to which your contributor refers, we send you herewith the reprint of the report of discharges made in July, 1896, and November, 1897, and the accompanying letter from Mr. Sappey, which speak for themselves. The cells have been subjected to 16 months intermittent and very hard work in driving a heavy carriage in the streets. We have indisputable and documentary proof of the working of the battery in a heavy street traction for over 18 months.

If your contributor would like to examine these proofs or to make an actual test of our accumulator for himself, we shall be pleased to place all the facilities for doing so at his disposal.

The Eclipse Brass and Copper Company, Limited.
A. S.

Halifax, *May 2nd*, 1899.

November 5th, 1897.

Baron R. de Watteville, Paris.

Dear Sir,—In reference to the question of the durability of the "Victoria" accumulator, I think the most satisfactory way of answering that question is to give you the results of some tests made on the battery in July, 1896, in November, 1897.

I enclose copies of these discharges from which you will see that there has been very little (if any) falling off in the capacity of the battery during 16 months, although it has been working in an intermittent and very disadvantageous way for the battery. That the active material, the subject matter of this invention, is a remarkable improvement in accumulator construction, is without any question.

(Signed) R Sappey.

No. 1. — Décharge d'un accumulateur "Victoria" destiné à rentrer dans une batterie de 100 éléments. Faite à la date du 8 Juillet, 1896.

Temps.	Courant à circuit ouvert.	Force électro-motrice. 2·2 volts.
		Potentiel.
...	35 amperes.	1·97 volts.
½ heures.	34 „	1·97 „
1 „	34 „	1·93 „
1½ „	34 „	1·91 „
2 „	34 „	1·85 „
2½ „	33 „	1·8 „
3 „	32 „	1·7 „
	Arrêt des essais.	

No. 2.—Décharge d'un accumulateur "Victoria" destiné à rentrer dans une batterie de 100 éléments. Faite à la date du 10 Juillet, 1896.

Temps.	Courant à circuit ouvert.	Force électro-motrice. 2·05 volts.
		Potentiel.
...	42 amperes.	1 9 volts.
½ heures.	42 "	1·9 "
1 "	41·5 "	1·88 "
1½ "	41·5 "	1 8 "
2 "	39 "	1 7 "
	Arrêt des essais.	

No. 3.—Décharge du même accumulateur "Victoria" sorti de la batterie de 100 éléments, après 16 mois de travail variable—en date du 2 Novembre, 1897.

Temps.	Courant à circuit ouvert.	Force électro-motrice. 2·1 volts.
		Potentiel.
...	28 amperes.	1 95 volts.
½ heures.	27 "	1 95 "
1 "	27 "	1 95 "
1½ "	27 "	1·95 "
2 "	27 "	1·94 "
2½ "	26·5 "	1 904 "
3 "	26·5 "	1·904 "
3½ "	26 "	1·81 "
4 "	25 "	1 72 "
	Arrêt des essais.	

Décharge du même accumulateur "Victoria" sorti de la batterie de 100 éléments, après 16 mois de travail variable en date du 3 Novembre, 1897.

Temps.	Courant à circuit ouvert.	Force électro-motrice. 2·3 volts.
		Potentiel.
...	35 amperes.	1 9 volts.
½ heures.	41·5 "	1·95 "
1 "	41 5 "	1 905 "
1½ "	41 "	1·89 "
2 "	40 5 "	1 87 "
2½ "	39 05 "	1·7 "
	Arrêt des essais.	

Electric Piping.

I have read with interest the articles under this heading which have recently appeared in your papers.

It is satisfactory to note that electrical engineers are at length awakening to the necessity of providing an improved system for the wiring of buildings for electric light and power. No system has as yet been devised which can be considered perfect, and so widely divergent, and, in many ways opposite, are the qualifications which a system to be perfect must possess, that, it is very far from probable, this ideal will ever be attained; it is, however, possible to combine the qualities of a system with careful workmanship, and thus obtain very nearly perfection.

In many cases a water-tight system is imperative, and the atmospheric conditions in this country are such, that in every case water tightness is a very important advantage, and no system can be considered perfect which is not water-tight. Water tightness implies dust tightness, and this is very often a point of nearly equal importance.

With all due respect to the authority from whom Mr. Waterhouse quotes, I do not think that we can treat the question of fire as a "bogey." It is an undeniable fact that fires can originate, and have originated, in electrical work, and while it is no doubt true that most, if not all, electrical fires are due to the bad work which is, unfortunately, far too common in this country, yet the question must be faced, and all systems condemned which are not, within reason, fire-proof.

To me it seems that too much is being made of what Mr. Waterhouse terms "mechanical protection." We must remember that thousands of miles of gas piping are in daily use in this country, and that even though much more serious consequences may result from the cutting of a gas pipe than from the cutting of the lead sheathing of an electric cable, it has not been found necessary to run gas pipes in steel tubes. We must also remember that it is not the general custom to use the walls of a building as a pin cushion, and riddle them with nails as the advocates of conduit wiring would have us to suppose. Many thousands of lamps are wired both in England and Scotland on lead-covered systems without additional protection, and, as far as my own experience goes, and from the report of other engineers who have executed large contracts on such systems, I am strongly inclined to the opinion that in general no further protection than the lead sheathing is necessary. Where cables are subject to unusually rough treatment a lead-sheathed cable can be efficiently protected by an armouring of galvanised iron wires laid outside the lead, or by passing the cable through a piece of gas barrel or similar tubing; in most cases, however, the cable can be so placed as to be quite out of danger. I do not for one moment wish to deny the advantage of a system proof against all attacks, but "mechanical protection" seems to me to be bought at too dear a price if it involve the sacrifice of the water and dust proof qualities of a system; and if it necessitate the "drawing in" of cables into tubes with bends and tees of more or less rugged interior, and the liability of seriously injuring the cables during this operation, it is a questionable benefit.

G. A. Clark.

We have read the article contributed to your issue of April 28th, by Mr. L. M. Waterhouse, A.M.I.C.E., and E.E., on "Electric Piping," and quite coincide with the views he expresses. Hitherto, we have used wood casings for our wiring, but are pleased to say that we have adopted of late the "tubing" manufactured by the Simplex Steel Conduit Company, Limited, and found that the results were eminently satisfactory, and in cost much less than wood casing, taking into consideration the labour involved in putting up. The jointing can be made quickly, and appears to have a neater finish; the system takes up less room than wood casing. For ship work and all heavy installation wiring it is of great service. Doubtless, time will come when the system introduced will be universally adopted.

Troup, Curtis & Co.

I have read with great interest the excellent discussion which has followed your leaders on the above subject. I should like, with your permission, to ask one or two questions.

Is or is not a twin wire advisable; if so, will an ordinary twin flexible be best (of course I do not mean silk covered, but workshop 36/40's say), or a twin cable of ordinary section—say, two wires each of 3/22's?

The Simplex Company manufacture ceiling boxes fitted with a cord grip only, which necessitates the use of twin cable and are impossible to loop.

Again, twin wire is very inconvenient for connecting up the switches, unless a three-contact set ceiling rose is used, such as that described by Mr. Isherwood. Perhaps he will kindly tell us where these roses can be obtained?

Again, as regards switching, for buildings of a more or less public character, a combined fuse and switch distribution board meets all requirements, but in private residences, offices, &c., the distribution box should only contain the fuses, switches for general lights being by the doors; and for desk, dressing table, portable fittings, &c., a combination switch holder is undoubtedly the most convenient. It remains for some enterprising firm to get out a perfect high voltage switch of this type.

I fully endorse Mr. Burchell's remarks *re* bending—at any rate, as regards the unbrazed conduit. I think some boxes designed to be screwed on to the sides of floor joists would be more convenient for concealed work than suspending them from the pipe or screwing to the bottom side of a joist.

C. B. Nixon.

May 6th, 1899.

Society of Arts Conversazione.—The Society of Arts conversazione will take place at the Natural History Museum, Cromwell Road, S.W., on Tuesday, June 20th.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday decided to advance £4,820 to the Hammersmith Vestry for electric lighting purposes, and £10,200 to the Strand Board of Works for the erection of a refuse destructor.

London United Tramways.

The position of the three "dead ends" of the system of the London United Tramways Company again came before the Council in a report by the Highways Committee, who referred to the offer made by Mr. J. C. Robinson in October last. It may be remembered that the Council then decided to consent to application being made by the company for power to reconstruct, in accordance with the overhead trolley system, the tramways in that part of Uxbridge Road between the Askew Arms public house and the railroad station, on condition that the company should also reconstruct, according to an underground system of electrical traction, the tramways from Uxbridge Road railway station *viâ* Goldhawk Road to Young's Corner, and from Young's Corner *viâ* King's Street to Hammersmith Broadway, and submit for the Council's approval full plans, details, and other particulars of the works.

The Highways committee now reported:—

The company subsequently asked for a modification of these conditions, and in support of this request, stated that it had, at the urgent request of the Vestry of Hammersmith, just completed the relaying of the Goldhawk Road tramways as a double line, which was equipped, with the exception of the electric conductors, for working on the overhead system. Having given consideration to this request, we informed the company that, having regard to the expenditure (stated to be about £20,000) recently incurred by it in repaving the Goldhawk Road, and to the serious inconvenience which would be caused to the inhabitants by the road being again disturbed for the reconstruction of the tramways, we were prepared, provided that the company would give an undertaking to lay down, on the terms stated in Mr. Robinson's letter of September 27th, an underground electrical system of traction for use on the tramways from Young's Corner *viâ* King Street to Hammersmith Broadway, to recommend the Council to modify its resolution of October 18th, and to give its consent to the use of the overhead trolley system, instead of an underground system as specified in the resolution, on the tramways from Uxbridge Road railway station *viâ* Goldhawk Road to Young's Corner, the other terms and conditions of the resolution remaining unaltered. The company has accepted the terms as modified, but has asked that it may be made quite clear that, as regards the underground construction of the tramways from Young's Corner to Hammersmith Broadway, which will obviously form an integral part of the tramways, the conditions stated in Mr. Robinson's letter of September 27th as to giving up to the Council free of cost certain electrical appliances, shall not apply. We think that this request is reasonable, and that this particular piece of line should, when the proper time arrives, be purchased at its then value.

The Committee therefore recommended the Council to consent to the company applying for power to introduce the trolley system on the two sections referred to, on condition that an underground system should be constructed on the Young's Corner to Hammersmith Broadway line.

Mr. Bull, on the motion for the adoption of the report, asked the chairman of the Highways Committee to take it back in order that the Hammersmith Vestry might be consulted in regard to the proposal.

Mr. J. W. Benn, in reply, stated that he had no objection to a postponement, and this was agreed to.

Lewisham Lighting Order.

It was announced that the Board of Trade had forwarded a copy of the Lewisham district electric lighting order in the form proposed to be granted, and that most of the amendments suggested by the Council had been included. The Highways Committee stated, however, that those relating to a reduction in the standard price per unit and to the supply of energy by continuous current had not been adopted by the Board. The Committee stated that they were already in communication with the Board with regard to the general question of the reduction in the standard price per unit, and did not consider it advisable to press the second point as to method of supply.

PARLIAMENTARY COMMITTEES.

Salford Corporation Tramways.

The Earl of Lauderdale presided over a Select Committee on Wednesday to consider the Bill of the Salford Corporation, by which the Corporation are asking for powers to reconstruct their tramways on the electric system, to purchase tramways outside their district, and to obtain sanction to make agreements with outside districts for working tramways in conjunction with their own; also powers to carry out street improvements and other matters.—Mr. Fitzgerald, Q.C., in stating the objects of the Bill, dealt first with the history of the Salford tramways, and explained that in 1875 the Corporation obtained powers to construct tramways, and constructed a system throughout the borough. Further powers were obtained in 1889, and the tramways were leased to the Manchester Carriage and Tramways Company. That lease would expire in 1901, and it was the intention of the Corporation, upon the expiration of the lease, to work the tramways themselves, and to convert them into electrical tramways. They had taken powers in the present Bill to reconstruct the whole system of tramways, and the fresh powers they were asking for were confined to the additional lines now proposed, and to work the tramways by electricity. There was no opposition to any of the new lines, nor was there any opposition to the working of the lines by electricity. With regard to the petitions, opposition was offered by the railway companies simply for protective clauses where the tramways were reconstructed across their bridges. That, he thought could be arranged. The first serious petition against the Bill was that of the Swinton and Pendlebury Urban District Council, who had leased the tramways in their district from the Manchester Carriage and Tramways Company, and had power to purchase at the end of the lease. They objected to Salford having the power to purchase the tramways in their district. He contended that the District Council failed to show a single instance in which they were affected by the Bill. The petition of the Eccles Corporation was much the same as that of the other local authority. They wished to manage their own tramways and objected to any interference on the part of Salford, but the latter Corporation did not intend to interfere with Eccles. The Manchester Ship Canal Company also petitioned, on the ground that the Salford Corporation proposed to bring their tramways to the swing bridge of the company in Trafford Road, which they urged would seriously interfere with the bridge and add to the difficulty and cost of working it, besides introducing new elements of danger. Mr. Fitzgerald said the tramway in question had already been authorised, and they had power at the present moment to construct the tramway. He contended that the three last-mentioned petitioners had no *locus standi* against the Bill.

After a considerable amount of evidence had been called both for and against the Bill the Committee adjourned.

On Thursday the consideration of the Bill was resumed, the principal question discussed being the clause under which the Corporation desired to obtain a strip of land belonging to the London and North-Western Railway Company close to the Exchange Station, in order to make a loop line of tramway to connect Pendleton, Broughton, and Manchester, and also have a tram terminus near the station. The company opposed the clause, and urged that they required their land themselves for extension purposes.

Mr. J. Corbett, the Salford borough engineer, said if the company sought to keep the strip of land for their present station, very serious objection would be raised by the Corporation. The land was necessary for the completion of the tramway scheme.

The Chairman announced that the decision of the Committee on the preamble of the Bill would be given the following day, after the clause relating to advertising hoardings had been considered by the parties concerned.

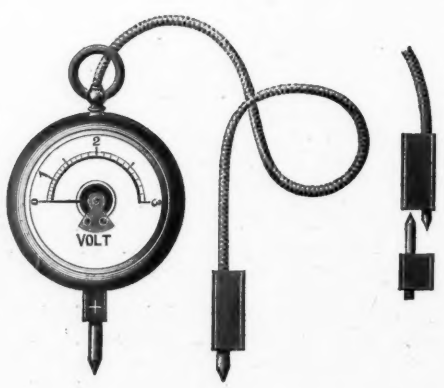
On Friday the Select Committee passed the preamble of the Bill after several clauses relating to rating and advertising boards had been adjusted.

Stretford and Withington Tramways.

The Stretford Tramways Bill and the Withington Tramways Bill should have come before Lord Lauderdale's Committee of the House of Lords on Thursday, but it was reported that the opposition to the measures had been withdrawn. Both provide for the working of trams within the two districts, the leasing, by agreement, of lines outside the districts, and the use of electrical or other mechanical power. Both districts have so far refused to come to an agreement with Manchester by which the city should manage the tramways, as it will do in many of the districts in the neighbourhood. The opponents to the measures were the Manchester Corporation and the London and North-Western Railway. Neither, however, appeared before the Committee, and consequently the measures will go before Lord Morley as unopposed Bills.

BUSINESS NOTICES, &c.

The Beez Pocket Voltmeter.—We illustrate below this new voltmeter which is being introduced to the trade by Messrs. Polland & Co., of Newcastle-on-Tyne. The Beez voltmeter has a



handy connector. The one pin connector is fixed to the instrument by a flexible cord; the second is loose. One end of it may be screwed into the meter when in use, but this second connector may

be pushed into the first one if it is intended to place the instrument in the pocket, so that both points are well protected. This arrangement permits of an easy and quick measuring of a large number of accumulator cells or primary batteries. The small connector can be easily screwed into the instrument, and as quickly removed. We understand that patents for these connectors have been applied for. The instrument, furthermore, is made on another patented galvanometric system, which prevents the hand from being affected by neighbouring magnetic fields or large masses of iron or strong passing currents. All the conducting metal parts are carefully protected and insulated so as to absolutely avoid the possibility of their touching the conduit when measuring.

The Copper Market and New Mining Companies.—The features of the month of April in the London copper market have been the unrest caused by the rumours of the American copper combine and the sharp rise in price due chiefly to the operations of the London agents of this syndicate. No very trustworthy details as regards the latter are yet obtainable, but there seems to be no doubt that the Standard Oil people have obtained a controlling interest in the Anaconda and Montana mines, and that they are buying up copper in the London market when any sign of a break in price is shown. The capital of the syndicate is stated to be $60,000,000, with a prospect of increase to $200,000,000 if other mines can be induced to sell—but the Lake Superior Company still refuses to enter the combine, and we hope it will maintain this negative attitude. The statement that the Rothschilds were interested in the syndicate has been authoritatively contradicted.

The rise in price during the month of April has been equal to £7 per ton, and has only been exceeded by that which occurred during January, when the price advanced from £57 10s. to £69 10s. per ton. The price of G.M.B.'s on April 30th was £77 per ton.

According to Messrs. H. R. Merton & Co.'s last fortnightly statement, the deliveries in March were 18,073 tons and the supplies 16,105 tons; a deficiency of nearly 2,000 tons. The fall in stocks at European ports, or afloat thereto, has been from 28,497 to 26,529 tons; but the rise in price is altogether out of proportion to this fall in the stock of copper, and can only be attributed to the operations of the syndicate's agents on the London and New York metal markets.

As regards the supplies of copper during April, the total of 16,105 compares unfavourably with the total of April, 1898, and it is of interest to give the analysis of these two returns from Messrs. Merton's circular:—

Country.	Supplies in tons.	
	April, 1898.	April, 1899.
North America ...	13,838	9,204
Spain and Portugal ...	1,958	1,986
Chili	2,200	2,050
Australia	1,150	1,700
Other countries ...	4,665	1,165
Total ...	23,811	16,105

The difference in totals amounts to no less than 7,706 tons, and of this, 3,500 tons is accounted for by the drop in the supplies from countries outside the regular ring of copper producing countries. It is difficult to explain the diminution in the shipments from these countries to Europe, except upon the assumption that the agents of the American combine have been at work, and have diverted to New York copper which otherwise would have come to European ports.

If this falling off in the shipments from outside countries continues, we are afraid that the present shortness of supplies may last some few months; and the prospects of a break in the high price at present prevailing are rendered more remote. In time, however, the re-working of old mines, and the opening up of new copper producing districts, must have some effect in reducing the price.

Since our last note on the copper market, two new mining companies have been brought before the investing public. The prospectus of the first appeared in the *Times* of April 24th, and of the second in the issue of the same paper for May 4th.

The former is the Colonial Copper Corporation, capital £125,000, and has been floated to purchase and work a property known as the Cow Flat Copper Mine in the Bathurst district of New South Wales. The purchase price has been fixed at £90,000, of which £7,500 is to be paid in cash, £50,000 in shares, and the balance in cash or shares.

The mines have been previously worked, but only the surface carbonate and oxide ore was taken, and the whole of the sulphides remain untouched. The amount of these sulphides is somewhat problematical, as no deep level shafts have yet been driven. The ore shows 4 to 10 per cent. copper, and 1 to 2 dwts. gold; also silver. A smelting furnace for treatment of 7,000—8,000 tons ore per annum is to be built, and the matte produced will be sent elsewhere for conversion into fine copper.

The latter company is the Einasleigh Freehold Copper Mining Company, with a capital of £200,000. It has been formed to purchase and work a freehold mine in the County of Gilbert, N. Queensland. The purchase price has been fixed at £140,000, of which total £25,000 is to be paid in cash. The samples of ore taken from this mine have assayed between 7·35 per cent. and 31·08 per cent. of copper, and it is estimated that the average value of the ore will be from 8 to 10 per cent.

The property is situated 75 miles from the nearest railway, and 28 miles from a projected government railway through the district. It is hoped that the latter may be diverted to touch the mine.

Under existing conditions it is estimated that the cost of placing copper on the European market will not be more than £30 per ton, freight and carriage charges being taken at £8 10s. per ton. As even with copper selling at £50 per ton, this estimate leaves a large margin for profit, it is difficult to understand why this property has never been worked. Mr. Woodhead, managing director of the British Broken Hill Proprietary Company, is vendor of the mine.

Owing to the further rise in the price of copper, we think it again advisable to draw attention to the relative costs of aluminium and copper when used as electrical conductors.

Using the formula given by Mr. Kershaw in his Electrical Review articles of September 2nd and December 16th, 1898, and taking aluminium at 14½d. per lb.,* and copper at 8·65d. per lb. (£80 15s. per ton).

We have for the relative cost of conductors of equal length and equal electrical resistance:—

$$\frac{8{\cdot}93 \times 8{\cdot}65 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4{,}557}{3{,}886} = \frac{117}{100}.$$

Copper is therefore at present prices, far more costly than aluminium, and if electrical engineers can obtain the latter metal in quantity they would do well to try what use they can make of it. Every ton of copper which can be dispensed with or displaced by some other metal at the present time, will help to bring about a collapse of the market; and if this collapse causes loss to fall on those whose financial operations have led to the present abnormal price, no one will be more pleased than ourselves.

The Charge against a Consulting Engineer.—At the Hyde Borough Police Court on Thursday last week, Henry Cleaver, of Southampton, described as an electrical engineer, was charged on remand with obtaining money by false pretences from Messrs. Stanley, Davies & Pollard, electrical engineers, Hyde. The circumstances of the case were referred to in the Electrical Review for April 28th. On Thursday last week Mr. Bostock made a long opening statement for the prosecution, and this was followed by evidence given by Mr. James Pollard, of the firm of Messrs. Stanley, Davies & Pollard. Mr. Pollard stated that the advertisement that appeared in the Electrical Review conveyed to him that by sending a guinea for a specification he should have a chance of tendering for a *bonâ fide* installation. If prisoner were a consulting engineer he would be paid by the persons for whom the specification was made. Mr. H. R. E. Dell, secretary to the Chloride Electrical Storage Syndicate Company, Limited, Mr. Henry Watts Cash, of the firm of Cash, Robinson & Co., Burton-upon-Trent, electrical engineers, and others also gave evidence for the prosecution. Defending the prisoner, Mr. Cooke laid stress on the fact that the case was of such a character that it was the duty of the Bench to ascertain from the evidence adduced for the prosecution whether there was a *prima facie* case or not. They could not decide the case. The proceedings that had transpired were only preliminary. The Chairman said: We think there is a *prima facie* case. He committed the prisoner for trial at the next Quarter Sessions on both charges. Bail was fixed at £50 in himself and two sureties at £100 each.

Covent Garden Theatre.—Among various improvements which are now about completed at the Covent Garden Theatre are the following:—The porch, vestibule, grand staircase, and saloon, has been redecorated, and the electric light has been installed in the saloon. A new smoking lounge being erected over the porch is also being electrically lighted. The most important alteration of the stage is the full installation of electric light in four colours, white, red, blue, and yellow being used, and the supply being taken from two distinct sources with the view of meeting emergencies. The system accords with the ordinary practice of the London stage, and has been put in by Mr. Bowles. A new feature, arranged by the directors is, however, the position of the regulator room below the stage, with a full view of the scene. The whole of the works have been carried out at great pressure under the personal direction of the directors, and of Mr. Edwin O. Sachs, their technical adviser. Possession of the Opera House was given to the syndicate on March 25th, so that the property has been in their hands for one month only. There will be no new stage machinery this season, nor will the auditorium be lighted by electricity; the time at the disposal of the directors was too short for these works. We are informed that it is possible by means of a very ingenious switchboard for one man only to control the 3,000 lamps which are distributed in exquisite combination of colours, among battens, borders, floats and proscenium. We understand the lamps were all supplied by the Crystal Electric Lamp and Rose & Bird, Limited, and the installation was carried out by Messrs. Townsend, Tamplin & Makarski, Limited, of Victoria Street, S.W.

Electric Launches.—The Thames Valley Launch Company, Limited, who, as already intimated, have bought as a going concern, the stock and business of the Upper Thames Electric Launch Company, including the electric charging station at Rod Eyot, Henley-on-Thames, wish all communications to be addressed to the chief offices of the company, Weybridge, Surrey.

Ernest Scott & Mountain, Limited.—The above firm are extremely busy at the present time with electrical transmission of power machinery, and amongst the most important orders which they have in hand are the following:—For the Great Northern of Ireland Railway.—A complete plant consisting of three engines and dynamos coupled, each of 250 H.P., together with switchboard, boosters, steam and exhaust pipes, feed heater, &c. This plant is for working the electric railway at Hill of Howth. For Chas. Cammell & Co.,

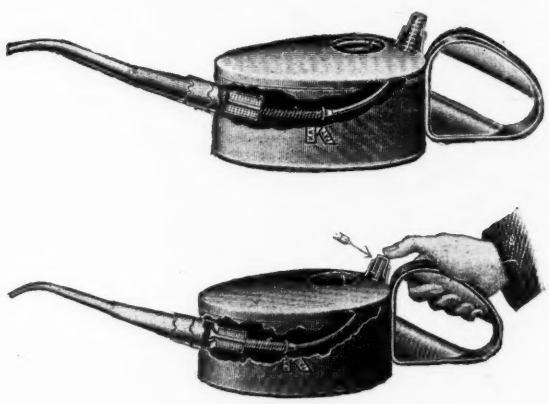
* Aluminium in bar and rod form, suitable for conducting purposes, has been offered at this price in Liverpool.

Limited, Cyclops Steel Works, Sheffield.—A complete transmission of power plant consisting of horizontal engine of 500 H.P. with generator, also a smaller engine and dynamo of 100 H.P., with electric motors for their armour plate department. For the Lanarkshire Steel Works, Motherwell, N.B.—A complete transmission of power plant consisting of two sets of coupled engines and dynamos of 300 H.P., and two similar sets of 150 H.P., together with electric motors, electric pumping plant, for delivering water from the River Clyde to their works, this plant pumping 1,000 gallons per minute; also the whole of the electric motors required for three 50-ton overhead cranes for lifting rolls, &c. For Richardson, Duck & Co., Stockton-on-Tees.—A complete electrical transmission of power plant, consisting of a generator of 150 H.P. with electric motors, &c., for shipyard. For the Dalmeny Oil Company, near Edinburgh.—A complete electric pumping plant with engine and dynamo of 200 H.P., set of three throw pumps to deliver 500 gallons per minute against a head of 600 feet. For Earl Rosslyn's Collieries, Dysart.—Electric pumping and hauling plant, the pumps being capable of delivering 150 gallons per minute against a head of 120 feet, through 800 yards of pipe; also endless rope haulage gear for dealing with the whole of the work underground. For the Broughton and Plas Power Coal Company, near Wrexham.—A complete electric haulage gear consisting of horizontal steam engine of 200 H.P., dynamo, electric motor of 150 effective H.P., and endless rope haulage gear to deal with the whole of the output from three roads. For the Consett Iron Company, Limited, Langley Park Colliery, near Durham.—A complete electric haulage gear consisting of engine and dynamo of 170 H.P., electric motor, and haulage gear to deal with the output from two roads. The firm are also supplying their combined engines and dynamos (the engines being of the self-lubricating type, as included in most of the above installations) for Messrs. Taylor, Garnett and Evans, Limited, *Manchester Guardian* printing offices, and also a large number of other installations of less importance. The type of engine referred to, *i.e.*, the self-lubricating type, is fitted with a valveless pump delivering oil under pressure to bearings and all other working parts, and this type of engine is finding considerable favour. The firm are extremely busy in this department, having fully 3,000 H.P. on order at the present time, of various sizes. The engine is made of either the compound two-crank type, or compound tandem three-crank type, and is made in sizes varying from 20 H.P. to 2,000 H.P. The firm have recently completed an extension to the electrical pumping plant at the Shilbottle Colliery, near Alnwick, as also an electric winding gear for the Glasdir Copper Mines, Dolgelly, together with two sets of their combined engines and dynamos for the Port Talbot Railway and Docks Company, South Wales.

Fire Protection for Lofty Buildings.—The question whether very tall buildings can be efficiently protected against fire is one which is just now evoking a good deal of interest in view of the recent serious conflagration at the Hyde Park Mansions. One of the chief reasons for any doubt on this point arises from the fact that during the day time the water pressure falls off to such an extent owing to the great demands made upon the supply for general use, that there is not generally sufficient pressure to throw a jet over the roof, or to be powerful enough to quench a fire of any size on one of the upper floors. It must be remembered that many fires occur in the daytime, as, for instance, the one at the Hotel Windsor in New York, and more recently the one mentioned above. Some means must, therefore, be adopted to increase the pressure of the supply available for fire-extinguishing purposes, and several courses are open. In buildings where access can be obtained to one of the high pressure mains of the Hydraulic Company's supply hydrants in connection with this can be taken to all the floors, and outlets with hose always attached, fitted. A plentiful supply is thus always to be depended upon for fire purposes. In many establishments, however, such an arrangement is not available, and to meet such cases, Messrs. Merryweather & Sons have designed a very efficient and inexpensive piece of apparatus, which is called a "pressure augmentor." This is fixed on any convenient wall on an upper floor, and is worked either by manual power or electrically, a low-pressure supply being raised by its means to one of great force and fire-extinguishing power. The immense block of residential flats known as Queen Anne's Mansions, near St. James's Park, have been fitted with a most satisfactory installation on the lines of the first-named principle; and the Constitutional Club, St. George's Club, and many other public and private buildings have been fitted with augmentors with very satisfactory results.

London Electrical Cab Company, Limited.—In the Chancery Division of the High Court of Justice on Thursday, May 4th, Mr. Justice Byrne had before him an application in the matter of this company for relief under the Companies' Act of 1898 in respect of certain fully paid up shares. The vendors of the patent rights under which the company worked agreed to sell the patents to be paid in cash or shares. The vendors had received a certain amount in cash from two issues of shares, and in 1898 they agreed to take the balance, some £24,000, in fully paid shares. These were allotted, but no sufficient contract had been filed, and the applicants, the holders of shares, now asked that a memorandum in writing might be filed with the Registrar of Joint Stock Companies. Mr. Justice Byrne directed the filing of a memorandum in a form to be approved in Chambers, and directed that, on its being filed, it should operate as a sufficient contract.

Improved Oil Can.—Messrs. Joseph Kaye & Sons, Limited, of Leeds, and High Holborn, London, send us particulars of an improved oil can specially suited for electrical engineers. Messrs. Kaye were the first to produce a seamless oil can fitted with a slide feed hole, and in the earlier types this was made of tin; the new oil can is made of copper, and is seamless throughout. The improvement otherwise, in the new type, is in the valve thumb button, which is loose (not soldered as hitherto) and when the pressure is removed the spiral spring within the sleeve A pushes the button back to the seating, forming a valve and closing the top of the



can, thus preventing waste. In the earlier types the button was soldered on, and liable to be broken off, leaving only the sharp end of the valve spindle. Our illustrations show the interior arrangements of the can. We have seen samples of both old and new types, and the latter seems to us to be a really reliable article.

Prism Globes.—Mr. Eadley Stanley, managing director of the Prism Globe Syndicate, Limited, gave an exhibition of prism globes at the Royal Institution, Albemarle Street, on Friday evening last. The globes were placed over all the naked lights hanging from the ceiling, and over the reading and writing tables, and their brilliancy and the effective way they diffused the light elicited very flattering compliments from those present.

Shop Window Lighting.—The "Rex" outside shop window lantern has been specially designed for use with outside shop windows, and is specially adaptable for drapers, milliners, hosiers, &c. The globe of the fitting is of half opal glass, and this side of the globe being placed furthest from the window it reflects the light on

to the goods displayed in the shop at the same time permitting of name or bold advertisement being painted on same. The carriers are finished in black, white, or blue enamel with gold lines, and, complete, the fitting presents a handsome and effective appearance, at the same time being inexpensive. The fitting is arranged to take three lamps of 8-C.P. to 32-C.P., and is provided at the top with a socket to screw on half-inch iron pipe. It is being made by the Edison & Swan United Company.

The Unbreakable Pulley and Mill Gearing Company, Limited.—This company inform us that Messrs. Titley and Kissack, of 4, Canning Place, Liverpool, have ceased to act as agents for their manufactures, and they are now represented in Liverpool by Messrs. Patz, Curphey & Co., 19 & 20, Strand Street.

Electrical Wares Exported.

Week ending May 10th, 1898.		Week ending May 9th, 1899.	
Algeciras	Value £35	Aden	Value £89
Amsterdam	295	Alexandria	50
Antigua. Teleg. mat.	11	Amsterdam	50
Antwerp	32	Antwerp	340
Auckland	690	Batoum	11
Bermuda. Teleph. mat.	10	Beira. Teleph. mat.	114
Boca	16	Bombay	293
Bombay	65	Buenos Ayres	856
Boulogne	27	Calcutta	249
Buenos Ayres. Teleph. mat.	20	Colombo	88
Calcutta	26	Copenhagen	107
Cape Town	289	„ Teleg. cable	227
Colombo	286	Durban	1,136
Delagoa Bay	44	„ Teleg. mat.	236
Dunkirk	15	East London	1,002
Durban	437	Fremantle	277
East London	725	Gibraltar	18
Fremantle	671	Hong Kong	10
Halifax	700	Madras	15
Lisbon	80	Melbourne	117
Madras	88	„ Teleg. mat.	248
Malaga	90	Perth	245
Melbourne	30	Port Elizabeth	60
Port Elizabeth	87	Rio Janeiro. Teleg. mat.	76
Rotterdam	35	Rotterdam. Teleg. mat.	246
St. Petersburg	85	Santos	257
Shanghai	190	Shanghai	15
Singapore	10	Singapore	97
Spezzia	892	Sydney	1,826
Stockholm. Teleg. mat.	118	Townsville	1,106
Sydney	88	Vladivostock	90
Wellington	327	Wellington	116
Yokohama	100	„ Teleg. mat.	167
		Yokohama	1,050
Total	£6,964	Total	£10,200

Foreign Goods Transhipped.

Alexandria. Teleph. mat.	£78	Perth. Electrical machinery	£900
Barcelona. Electric tram plant	10,600		
Malaga	276		
Stockholm. Teleph. mat.	22		
Total	£10,971	Total	£900

Aluminium Castings.—The popularity of aluminium castings for engine and machine work is considerably increasing, and there is a likelihood of brass and copper being to some extent replaced for such portions of engineering work as have hitherto utilised the older metals. The Eclipse Brass and Copper Company, Limited, of Halifax, who make a speciality of aluminium castings, have recently obtained an order for the whole of the fittings in this new metal for the parts of engine and gearing of 30 large steam omnibuses, and the vaporisers, crank chambers, silencers, &c., of a score of oil-driven engines of different types. We are informed that the special alloy, which enables this metal to be turned, bored, and threaded equally as well as gun metal brass, is possessed only by this firm, and that the prices of the castings are about the same as for brass.

Auction Sale.—Messrs. Smiths, Limited, have received instructions from the Trustee under a deed of assignment to sell by auction on Monday, 15th inst., the plant, &c., of T. M. Hewitson, Colonial Works, 138, Suffolk Street, Birmingham. There are gas engines, a dynamo, boiler, piping, and various electrical and other apparatus and fittings to be offered.

Bankruptcy Proceedings.—Under the failure of H. Kirk & Son, electrical engineers, 251, Fulham Road, the debtors attended last week at the London Bankruptcy Court, and passed their public examination upon accounts showing debts £770 13s. 10d. and assets £344 10s. 3d. The business was started in 1897 at 99, Drayton Gardens, and was there carried on until the landlord distrained in September, 1898. It has since been continued at 251, Fulham Road. The debtors attribute their insolvency to their inability to get in book debts, to heavy expenses at Drayton Gardens, and to loss through the distraint before referred to.

The public examination of John Evelyn Liardet was ordered to be concluded last week at the London Bankruptcy Court. The debtor in the course of his evidence stated that he was largely interested in water motors, electrical accumulators, and hydraulic apparatus for irrigation purposes in connection with which he had rented the Old Mill Works, Cowley. His appearance at the Court was due to his inability to realise the patents to advantage. The accounts filed under the proceedings show liabilities £5,647, against assets valued at £19,000, but proofs amounting to £10,757 had been admitted by the trustee, and the creditors have accepted a composition arrangement providing for 7s. 6d. in the £. The Official Receiver has reported that having regard to the nature and uncertain realisable value of the assets, the offer appears calculated to benefit the general body of creditors.

Mr. T. H. Kaye, 4, Ramsden Street, Huddersfield, has been appointed trustee in the case of J. E. Stott (J. E. Stott & Co.).

According to notice in the *London Gazette* a first and final dividend of 11½d. in the £ is payable on May 18th in the case of F. Jones, electrical engineer, New Wandsworth, at the office of the Official Receiver, 24, Railway Approach, London Bridge, S.E.

The case of David Cook, electrical engineer, 165, Queen Victoria Street, E.C., came before Mr. Registrar Giffard at the London Bankruptcy Court last Wednesday, upon the debtor's public examination. The debtor formerly acted as general manager and chief engineer of the City of London Electric Lighting Company, but left their employ at the end of 1894 in consequence of ill health. He next started speculating in shares, and by October, 1895, he had acquired in that way some £25,000, but has since lost £35,000 and now owes £30,000. It was intimated that arrangements were in progress for the payment of a composition and his Honour adjourned the examination until June 7th.

W. A. Charles and J. S. Blackwell electrical engineers, Leicester and London, trading as the Central Electrical and Engineering Company, attended last Wednesday at the London Bankruptcy Court, and were allowed to pass their public examination upon accounts showing liabilities £1,726 (unsecured £1,423), and assets £571. They stated that in 1897 they commenced business at Leicester, and later in the same year they rented showrooms in London. Their failure was due to the unsuccessful attempt to float the Steady Arc Lamp Company, Limited, with a view to putting before the public their patent lamp.

Mr. R. W. Marsden, 52, Belvoir Street, Leicester, has been appointed trustee in the case of W. A. Charles and J. S. Blackwell (Central Electrical and Engineering Company).

Liquidations, Dissolutions, &c.—A petition for the winding up of Messrs. Nalder & Hilton, Limited, will be heard at the High Court before Mr. Justice Wright on May 17th. The petition was presented by a creditor, Mr. A. Wheeler, of Byne Road, Sydenham.

Messrs. L. E. Bowden and F. E. Higlett (Bowden, Higlett & Co., electrical engineers, Onslow Street, Guildford, and Dorset Street, Salisbury Square, E.C.) have dissolved partnership. Debts will be attended to by Mr. Higlett.

Books Received.—"Electro-Magnetic Theory," by Oliver Heaviside. Vol. II. *Electrician* Printing and Publishing Company. 12s. 6d.

"15 Lezioni Sperimentali su la Luce considerata come fenomeno elettromagnetico," by A. Garbasso. Milan: Editori della Rivista L'Elettricita.

"Il Montatore Elettricista," 4th edition, by Ing. E. Barni. Milan: Editori della Rivista L'Elettricita.

Catalogue.—Messrs. C. W. Treacher & Co., of Queen Victoria Street, send us an illustrated catalogue (30 pages) of electric light material, including plant and accessories for lighting equipments. There are some general notes on wiring and running small installations, also particulars of accumulators, electroliers, and a variety of other requisites.

The London Vestries and Maps of Areas of Supply.—The London County Council is sending to each of the vestries having their own electric lighting stations a letter requesting the supply of maps in relation to areas of supply and other matters in connection therewith. The Council is apparently exceeding its powers in its demands as the following letter, addressed by the Clerk of the Council to the St. Pancras Vestry, will show. The letter, which is typical of those forwarded to the Shoreditch and other vestries, is as follow:—

I have been directed to call the attention of the Vestry of St. Pancras to the fact that the Electric Lighting Order, confirmed by Parliament, under which your Vestry, as the undertaker under the Order, supplies electrical energy in the areas specified in the schedule attached to the Order, requires that "the undertakers shall forthwith, after commencing to supply energy under this Order, cause a map to be made of the area of supply, and shall cause to be marked thereon the line and the depth below the surface of all their then existing mains, service lines, and other underground works and street boxes, and shall once in every year cause such map to be duly corrected, so as to show the then existing lines," and "shall also, if so required by the . . . County Council, cause to be made sections showing the level of all their existing mains and underground works other than service lines." And it is further provided that "the undertakers shall, if so required by the . . . County Council, supply to them . . . a copy of any such map or section, and cause such copy to be duly corrected so as to agree with the original or originals thereof as kept for the time being at the office of the undertakers."

The Council, having every desire to allow the undertakers a free course in the conduct of their business, and not to require that information not immediately wanted should be given prematurely, has hitherto refrained from asking for compliance with the statutory requirements above quoted. As, however, most of the Orders were granted some years since, and the obligations of the undertakers as regards the supply of electrical energy in their respective areas have been to a great extent fulfilled, I have been directed to ask that your Vestry will, as soon as possible, in compliance with the above requirements, supply the maps and particulars specified therein. The number of the section containing these requirements is not the same in all the Orders; but I may mention that the heading of the section is "Maps," and the side-note "Map of area to be made and deposited."

I have to ask that you will be good enough to inform me at what date the maps and particulars can be supplied to the Council.

The Electricity Committee of St. Pancras Vestry, in reporting upon the request, state that the County Council have no power to prescribe the scale of map, that power being reserved to the Board of Trade. The Committee also state that it is not incumbent upon the Vestry to cause to be made sections showing the level of all existing mains and underground works at the requirement of the County Council. The Vestry have supplied the Council from time to time with plans and maps of the extensions of mains, carried out on a scale agreed upon between the engineer to the County Council and the Vestry's electrical engineer, and these maps have been completed to the end of 1897. The St. Pancras Vestry have therefore decided to inform the London County Council that they have fulfilled their obligations in this respect to the close of 1897.

The Electrical Power Transmission Company.—A new concern under the above name has been started at Albert Works, Hammersmith, for the purpose of supplying plant for the electrical transmission of power, and also to manufacture several special electrical appliances, particularly a newly patented automatic motor switch, which fulfils all the requirements of the most exacting Corporation engineers, and has other points entirely novel. The company has taken over the patent of, and are manufacturing, a new arc lamp of a very simple and reliable character. From the nature of their contract business, the company will have many orders to give out to the trade, in connection with indents received from its connections in the Colonies, for all classes of electrical work. No company has yet been registered, the business being under the direction and on account of Messrs. Powell-Jones & Co., 7, East India Avenue, who have large

connections in the East, but a limited company under the above name will be registered shortly, of which the above firm will become managing agents. Mr. Walter F. Jones, A.M.I.E.E., M.I.Min E, late of Messrs. P. R. Jackson & Co, and formerly of Messrs. Easton, Anderson & Goolden, has been appointed manager and engineer at the works.

Electricity in Cardiganshire.—It is stated that the Frongoch Mining Company purpose, after completing extensive improvements in the work and mode of working their mines, to work them by electricity.

Removal.—The British Thomson-Houston Company, Limited, have moved their Glasgow office from 63A, St. Vincent Street, to 141, West George Street.

Report of the Grosse Berliner Strassenbahn A. Gesellschart.—We take the following details of the progress of this company from the issue of the *Elektrotech. Zeitschrift* for March 2nd, 1899. The contrast between London, which does not yet possess a single mile of street electric tramway, and Berlin with 97·3 kilometres (or 60 miles) is striking. The equipment of the company's lines with electricity is proceeding. The three lines of the company in 1896 have now grown to eight lines, with 319 kilometres of track. About one-third of this is worked electrically, and of this latter total 22·97 kilometres (or 14 miles) is worked by accumulators. In 1898 the company carried 172,000,000 persons, an increase of 8·38 per cent. upon the number carried in 1897; and the receipts for fares amounted to £912,468. The car miles run in 1898 were 23,389, and the total expenditure was £499,741. The gross profits for 1893 were £430,894, and adding the sum carried forward from the previous account, the total available for distribution is £439,831. The net profit is £219,146. The original shareholders receive a dividend of 18 per cent. upon £1,068,750 of share capital; and after placing sums to the reserve, repairs, track re-laying, and sick and pension funds, £743 remains to be carried forward. The reserve fund now stands at £189,005; the repairs fund at £107,309; the track re-laying fund at £726,219; and the sick and pension fund at £32,568. The company employs 5,014 persons, owns 5,471 horses and 1,461 cars, 375 of which carry motors. Up to the end of 1898, £2,780,361 had been paid by the company to the city authorities for street repairs, rent of roads, and income-tax.

Smoke Nuisance.—At the Aberdeen Sheriff Court on 3rd inst., Mr. W. Duthie, Banff Villa, Cults, has applied for interim interdict against Messrs. P. C. Middleton & Co, electrical engineers, Cults, to prevent them from causing a smoke nuisance. After hearing the parties the Sheriff took time to consider the matter.

South African Electrical News.—The *British and South Export Gazette* for May says that an order for two hauling engines of powerful type, to be driven by either electricity or compressed air, may shortly be expected to be placed by the Lancaster West gold mine.—The order for a high speed engine, of sufficient power to drive a dynamo of 525 volts and from 60 to 100 kw. capacity, has just been placed by the Johannesburg Town Council.—A third generator on the three-phase system, from the works of Messrs. Brown, Boveri & Co., Switzerland, is about to be added to the equipment of the General Electric Power Company, Johannesburg. It will be of 500 kw., 3,300 volts, and a speed of 75 revolutions per minute. The field of the generator will be excited by two continuous current shunt-wound dynamos, each of 24 kw. at 75 volts, running 450 revolutions per minute, manufactured by the Electric Construction Co., Ltd., Wolverhampton. Room for a fourth generator has been provided.—A new electrical plant is on order for lighting, driving and hauling purposes at the Ferreira gold mine. After receiving the report of the Borough Engineer on the cost of installing an electric lighting system in the municipality, the Newcastle (Natal) Town Council have determined to defer the carrying out of the scheme for the present, on account of the cost. It has, however, been decided to acquire a small electric plant to light the Town Hall.

Trade Announcements.—Messrs. H. A. Wood & Co., have removed to 71, Newington Butts, where they will exhibit various electric lighting, heating, and cooking apparatus, also motors and dynamos. Mr. H. A. Wood will continue to look after the Blackpool business, while Mr. C. J. Wood will watch over the London and Southern Counties work.

The General Electric Company have acquired the business from Messrs. Gullette & Co., manufacturers of electrical apparatus of every description, White Horse Electrical Works, Cowcross Street, E.C., having purchased their tools and plant. Mr. J. W. Gullette also has permanently joined the staff of the General Electric Company as a technical manager in their Peel Works, Manchester, to superintend the manufacture of high class telegraph, electric bell, and telephone instruments.

Messrs. Spurgin & Co., have opened offices in Cowgate, Peterborough, as electric light contractors.

ELECTRIC LIGHTING NOTES.

Barking.—Last Friday night the electric light was switched on to a number of private consumers. The formal switching on for street lighting takes place in the course of a few days.

Barrow.—The Council has resolved to instruct Messrs. Kincaid, Waller & Manville to prepare plans and specifications for extensions to the electricity plant, and tenders will be invited and accepted, subject to the consent of the Local Government Board being obtained.

Bath.—The noisy arc lamps seem to be giving rise to a great deal of trouble. At the last meeting of the Electric Light Committee they again came under discussion, correspondence from Mr. Hammond being read. Mr. Hammond in a report said that the contractors proposed to deal with the noise nuisance by reducing the pressure on all the lamps. With that in view, they had prepared a batch of 10 choking coils for immediate trial. They had overhauled the mechanism of all the lamps, in order to put them in a uniform condition. The contractors disclaimed individual responsibility, because inferior carbons were being used, and the pressure at the circuits was not kept uniform. He recommended the Committee to remove any doubts the contractors might have on that score. Mr. Metzger said they had used the same make of carbons as the contractors recommended. The Committee decided to draw up a statement containing the pith of what the chairman, Mr. Metzger, and Mr. Isaacs had said, for the perusal of Mr. Hammond. A statement prepared by the clerk as to the finances of the electricity undertaking shows that the revenue account is overdrawn by £1,534, and the capital account (less £4,500 to come in) to the amount of £3,759. A proposal to adopt a sliding scale of charges was deferred until the Committee can give it full consideration.

Beckenham.—A Local Government Board inquiry was held last week regarding the Council's proposed loan for £37,160 for the electric light scheme. During the past seven years since the provisional order was obtained, schemes have been prepared by Mr. Gisbert Kapp and Mr. R. P. Wilson. In November last the Board of Trade informed the Council that unless the order were put into operation without further delay it would be revoked. The Council acquainted the Board of Trade with the steps being taken, and received in reply a letter postponing for six months the question of cancelling the order. In reply to the invitation to undertake the supply of the whole plant and machinery, the lowest and most favourable tender was from the British Insulated Wire Company, Limited, in the sum of £25,054. Tenders for buildings and chimney and four house refuse destructors forming the generating station were about to be invited, and were estimated to cost £12,046. The loan for which sanction was applied for was therefore made up as follows:—The British Insulated Wire Company's tender, £25,054; estimated cost of buildings and chimney, roadway and dust destructors, £12,046.

Belfast.—The Belfast Council has appointed a sub-committee to visit Glasgow and several other cities for the purpose of seeing a special type of mechanical stokers, as applied to water-tube boilers, working, and several other matters in connection with electrical stations generally.

Blackpool.—At last week's Council meeting Alderman Brodie submitted the statistics of the Electricity Department for the year ended March 31st. The income was £15,508, and the expenditure £8,044, leaving a gross profit of £7,464. Deducting interest and sinking fund, amounting to £5,324, there was an available balance of £2,140. It had been argued that now that the electricity works were being made to pay, a reduction of the price for the light should be made. He reminded them, however, that some three years ago, 50 miles of their cables went wrong, and became absolutely useless. A suspense account was therefore created to the extent of £12,000, which had to be paid off, and until that was done there could be no general reduction in the price of electricity. Turning to the Tramways Department, he said the income had been £18,220, with an expenditure of £11,540, leaving a gross profit of £6,680. The interest and sinking fund absorbed £3,180, leaving an available balance of £3,500. The total mileage for the year was 259,754, as against 220,818 in the previous year, being an increase of 38,936. The total number of passengers carried was 2,881,027, as against 2,279,209, being an increase of 601,818, and of over a million on the year 1897. The electric energy for the tramway was supplied by the Electricity Department, and a charge of 2d. per unit was made. The total cost of traction, therefore, was £1,500 for the year, being a shade under 1½d. per mile. Now that the overhead system was being substituted, it was hoped that the cost would be reduced to under 1d. a mile.

Bognor.—The Urban Council has referred to the Electric Lighting Committee an offer received from gentlemen connected with the Bognor-Chichester electric tramway scheme to supply electric light to the town.

Bridge of Allan.—The Dunblane Commissioners resolved to sanction the application by Edmundsons' Electricity Corporation for the lighting of the two burghs by electricity, if the Bridge of Allan Commissioners sanction was obtained. The Bridge of Allan authorities will not consent to the proposed provisional order, so the scheme falls through.

Brighton.—In the £64,000 proposed loan for 1899 and 1900 referred to last week, the principal amounts are:—Boilers and steam piping, £6,600; condensers and cooling towers, £7,000; dynamo, &c., £5,500; new feeders, £21,900; new distributors, £7,500; and new house services and meters, £7,500.

Bristol.—In a report to the Council, the Electrical Committee state that they have been asked to join in a scheme for providing the necessities for an electrical wiring and installations on the hire-purchase system. The Committee have drawn up an agreement with the promoters, and this they advise the Council to enter into.

At Tuesday's Council, Mr. George Pearson, chairman of the committee, in moving that the authority be given, mentioned that the new alternators would be needed for the further development of the electrical station, and the order had to be given now, because they were informed the state of business in English

electrical houses was such, that there was little chance of getting machinery delivered in less than 12 or 16 months from the date of the order. The Electrical Committee had consequently pressed the matter on.—Mr. Levy Langfield remarked that America had been supplying a good deal of machinery lately, but he hoped this order would go to an English firm.—Mr. Pearson responded that it was much to be regretted that with English firms there should be this delay in manufacture; it was because the Electrical Committee were desirous of going to English firms the matter had to be pushed on. It was possible if they went to an American firm they might get the machinery—he did not say so good—but quicker.—Alderman Low (a director of the Bristol Tramway Company) could, he said, thoroughly confirm that. The committee's recommendation was agreed to.

Buxton.—The Local Government has sanctioned the borrowing of £24,769 for the electric light installation.

Camberwell.—The Vestry has empowered the General Purposes Committee to engage expert advice upon the question of acquiring the works of the County of London and Brush Provisional Company in that parish. The company is said to have expended £45,932 17s. 9d.

Canterbury.—The Town Council has decided that for incandescent lighting 16-C.P. lamps with duplex reflectors should be adhered to, except in open spaces or for lighting cross streets, when the prism lens will be used. The Local Government Board has sanctioned the loan for additional plant asked for by the civic authorities.

Cardiff.—At a recent meeting of the Lighting Committee, counsel's opinion was submitted with reference to the dispute with Messrs. Ferranti as to the delay in the erection of the engine at the works. Counsel advised that the Corporation had a good cause of action, and it was resolved that the town clerk issue a writ for the recovery of damages from Messrs. Ferranti. The penalty is claimed at the rate of 1 per cent. per week for the 2½ years, the percentage being based on the purchase price of the engine, £3,250.

In consequence of 10s. per ton advance in iron, Mr. Jackson, of Cardiff, cannot carry out the contract for lamp pillars without an extra 2s. 6d. each is added to the price of the 200 ordinary pillars and 3s. 6d. to the 25 special pillars. It was resolved to offer the contract to the next lowest tenderers, Messrs. Rogers & Co., of Pengam, and in case they do not accept, to advertise again.

Chelmsford.—The report of Mr. Hammond as to the undertaking of the Chelmsford Electric Lighting Company is under the consideration of the Lighting Committee, who will shortly report upon it. So far the report is termed "private to the Council," though rumour has it that £24,000 is set down by the consultant as a fair price, whereas the company wants £42,000.

Chelsea.—The Chelsea Electricity Supply Company is reducing its price for current to users on 200-volt supply after September 29th. The price will be 6d., from 6d. to 3d. per unit on the Wright maximum demand system, 100-volt consumers will have no reduction.

Crewe.—The Local Government Board has sanctioned the Council's application for a loan of £26,000 for electric lighting purposes.

Croydon.—Notwithstanding the loans which have been sanctioned for electric lighting by the Local Government Board, the Corporation have found it necessary to go to the Board again for power to borrow money for further extensions, and Col. W. R Slacke, R E, has just held an inquiry into the application of the Corporation for power to borrow £22,000 for station and main extensions. The principal part of this sum is required for extensions at South Norwood. At the inquiry Mr. Minshall, electrical engineer to the Corporation, informed the inspector that the number of private lamps had increased, up to March 4th, from 17,412 to 31,220 of 8 C.P. The revenue from private lighting now amounted to £31,000

Dawlish.—The Council has appointed a committee to consider a communication from Mr. Taylor *re* electric lighting.

Dollar.—The Burgh Commissioners last Monday considered an electric lighting scheme in private.

Dorchester.—Having considered communications received relating to the electric lighting of the town, the General Purposes Committee has recommended that no action be taken in the matter at the present time.

Durham.—The Council will ask the Board of Trade to re-insert the tranfer clause in its provisional order.

Ealing.—The Electric Light Committee reports 443 more lamps applied for, making a total of 22,443, of which 22,117 are connected to the mains.

Eastbourne.—Mr. H. W. Wilkinson, electrical engineer to the Electric Light Company, has informed the Electric Lighting Committee that he proposes taking up private practice as a consulting electrical engineer, and will not therefore seek appointment by the Corporation when it takes over the undertaking.

Edinburgh.—The other day the Electric Lighting Committee had before them the electric supply estimates, which showed that the ordinary expenditure for the current year, including sinking fund and contribution to the reserve fund, was £67,605, and the estimated revenue was the same. The estimated contribution to the reserve fund was £6,475. The estimated expenditure for 1898-99 was £50,950, including a contribution to the reserve fund of £7,000, while the estimated revenue was £55,450. The actual expenditure for 1897-98 was £35,025, including a contribution to the reserve fund of £460, and the actual revenue for the same period was £38,049. It was reported by the convener that the number of new lamps supplied for between April 14th and 27th was equivalent to 7,778 8-candle-power lamps.

Elland.—The District Council has before it a letter from English Industrials, Limited, of Manchester, asking whether the Council is open to deal with the question of erecting an electric station for light, power, and eventually tramways purposes for their district. The general opinion seems to be against allowing a company to have the monopoly.

Enniskillen.—The Urban Council has requested Messrs. Scott to prepare specifications for lighting the town hall by gas and electricity respectively. They are also advertising for tenders.

Epsom.—The Council has decided to consider along with the tenders when received for electrical plant, a letter received from an electric light company suggesting that if the matter were placed in their hands they would be able to supply at cheaper rates to consumers than the Council would be able to do with its own plant.

Erdington.—The chairman of the Council will move that application be made for a provisional order.

Eton.—The Urban District Council have decided to reconsider the question of lighting the town by electricity, and a committee has been appointed to make further inquiries into the cost, &c.

Exeter.—A new scale has been adopted for the supply of electricity for motive power. The price is to be 3d. per unit, except from 6 p.m. until midnight from Michaelmas to Lady Day in each year, when the charge will be the same as for current for lighting.

Farnham.—The District Council will hold a special meeting to discuss the electric lighting question in connection with Mr. Warden-Stevens's report.

Garston.—Last Friday's *London Gazette* contains notice of the intention of the Urban District Council to transfer its provisional order to the Garston and District Electric Supply Company.

Govan.—At a Dean of Guild Court last week the Govan Commissioners were granted lining for the erection of part of the proposed buildings in Helen Street in connection with the installation of electric light in the burgh. The buildings are to be of the character usual in such erections. The estimated cost of the whole installation, including mains, machinery, &c, is £20,000. Building will be commenced immediately, and it is expected that the principal streets will be lighted about the beginning of October.

Hamburg.—On 3rd inst., in the evening, owing to a short circuit in the main cable of the electrical works, more than half the city was thrown into darkness. At the same time many electric motors were rendered useless.

Hampstead.—The Vestry has decided to increase the electricity works staff by promoting Mr. J. Leadbeater to the post of chief indoor assistant engineer and engaging an additional assistant engineer.

Hanley.—The Town Council has resolved to apply to the Local Government Board for a loan to raise £4,000 for electric lighting.

Islington.—The Electric Lighting Committee report that they have considered the proposed extension of mains to the Hornsey Rise and Newington Green districts with a view to providing both a public and private supply, and a report by the engineer on the subject. If undertaken, the work would take a period of two years to accomplish, and as the extensions would prove to be advantageous the committee express the opinion that they are desirable, and that the scheme for lighting the thoroughfares in the Highbury New Park district by means of arc lamps, which has been held in abeyance pending the completion of certain experiments by Mr. Gay, the electrical engineer, should also be proceeded with at the same time. The committee, therefore, recommend that on the receipt of sanction to borrow the money, the several works should be carried out. In the course of his report Mr. Gay points out that 105 street arc lamps would be sufficient for the Hornsey scheme, and that the cost, including low tension mains and six transformers for both public and private supply, would amount to £34,000. With regard to the Newington Green project, the electrical engineer estimates at £26,000, the probable expenditure for conduits, pipes, cables, labour, including 56 street lamps and providing for low tension mains and four transformers for both public and private supply. On the subject of the public lighting of Highbury New Park district, it may be remembered that Mr. Gay asked the Electric Lighting Committee to defer the question until he had carried out certain experiments with arc lamps of the enclosed type. The electrical engineer now states that continued experience over a period of some 18 months has proved the unreliability of these lamps when compared with those at present in use, and that he is therefore compelled to abandon the idea of proposing the employment of enclosed arc lamps for that particular district. The engineer suggests that 72 arc lamps of a similar type to those already adopted in Islington should be erected at a cost of £7,150; and, as above mentioned, the Electric Lighting Committee recommend the Vestry to carry out all three proposals.

Kettering.—The Council has decided by nine votes to eight to call in an expert to draw up a report with a view to carrying out the electric lighting powers.

Kidderminster.—The Corporation has now transferred the 1891 provisional order to the Electric Lighting and Traction Company, Limited.

Leamington.—The Electric Lighting Committee has received a draft clause proposed to be inserted in the Corporation provisional order by the Board of Trade. A special meeting of the Council will be held to-day (Friday) to come to a decision on the electric lighting question.

Leatherhead.—A canvass of ratepayers is to be taken on the electric lighting question.

Limerick.—Last week the Corporation had before it a proposal signed by Charles W. Sax, on behalf of the Dublin District and Provincial Electricity Corporation, for acquiring the Limerick Gasworks. The conditions offered are—

1. That the provisional order for electric lighting granted to the Corporation by the Board of Trade be transferred to the syndicate. 2. That the order for lighting by gas be transferred to the electricity corporation. 3. That the syndicate take over the gasworks at a price agreed upon by qualified valuers. 4. That the electricity corporation should supply the public lighting at 3d. per unit, and the private lighting at a maximum of 6d. per unit.

The Council were not disposed to entertain the application, but appointed a committee to specially consider the question of giving effect to the order possessed by the Corporation. The Council adjourned an application from the Limerick Electric Tramways Company to promote electric tramways in Limerick until a duly qualified meeting was summoned.

Levenshulme.—The Manchester Electricity Committee informs the District Council that every effort is being made to supply Levenshulme with electric light, and it is hoped that everything will be completed, ready for the purpose, for next winter.

Longton.—The Town Council has referred back to the Electricity and Tramways Committee a proposal that Mr. Giles, the electrical engineer, also act as tramways manager at an additional £200 per annum. His present salary is £300.

Maidenhead.—The poll on the electric lighting question has resulted in 310 votes for a municipal plant and 118 votes for a company undertaking the work; majority for municipal control, 192. The Council has instructed the borough surveyor to prepare plans for electric lighting station to be erected on certain land already purchased by the Council for sewage disposal purposes. The Local Government Board is being asked to consent to the use of the land for electricity works.

Marylebone.—At the last meeting of the Marylebone Vestry Mr. E. White, L.C.C., asked what had happened with regard to the proceedings between the Metropolitan Electric Supply Company and the Vestry. The clerk said the matter was now in the hands of the solicitor, who had written to the company, asking them to stop the work that had been commenced pending the decision in the Court, and this had been done. The roads had been broken open without the leave of the Vestry, in contravention of the agreement entered into between the company and the Vestry. It was mentioned that the company applied to the Vestry in January last for permission to open the trenches in question, but the Vestry had not replied. On account of the prohibitive cost of electric street lighting inquiries are to be made by the Works Committee as to the cost of incandescent gas lighting for certain roads.

Middleton.—The Corporation has adopted an electric light scheme and will apply for power to raise a £20,000 loan.

Monmouth.—The chairman of the Drainage and Electric Light Committee reports that up to the present the demand for private and public lights was equal to 1,608 8-C.P. lamps. Two turbines would produce only 1,120 such lights, and deducting 20 per cent. for waste gave 884. However, as there would never be much more than half the lights required at the same time, they had sufficient power for the present, but fresh orders kept coming in every day, and a considerable saving would be effected by purchasing the turbine within the contract year. The consideration of the purchase of a turbine was adjourned for a fortnight.

Newport.—The Corporation last week passed minutes of the Electricity Committee, which included a report from the office manager, for the quarter ended March 31st, 1899, as follows:—

Period.	Total consumers to date.	Number of lights connected (including arcs) equivalent to 8 C.P. lamps.	Units to be paid for during the quarter (including arcs).	Cost of generation and distribution per unit.	Total costs (not including sinking fund and interest).	Total revenue (including meter rents).
					£ s. d.	£ s. d.
Quarter ended March 31, 1899	287	24,707	Inc. 79,538 Arc 32,303 111,840	2·15d.	1,004 2 10	2,027 14 0
Corresponding period last year	204	17,772	Inc. 53,232 Arc 30,071 83,303	2·40d.	852 16 8	1,526 1 4

669 more lamps have been applied for, and the present total connected and on order is 28,161 8-C.P. A sub-committee has been conferring with the town clerk regarding defence of the action brought by Mr. Stephen Taylor for an injunction to restrain the Corporation from working their electric lighting machinery. The borough electrical engineer has reported, giving a comparison of the capacity of the plant, with the number of lights connected, showing the plant, exclusive of the reserve machinery, to be overloaded. He is going into the question of "blowing off" the boilers, with a view to preventing steam from being discharged into the sewers, so as to be an infringement of the Corporation Act, 1889. An order has been given to the Electric Construction Company for an electric capstan (£155) for facilitating coal shunting.

Neyland.—The Parish Council, as it will not be permitted by the Local Government Board to put down an installation, is writing to a few contractors to know their terms for supplying the parish with electric light.

Perth.—The Electric Lighting Committee has conferred further with Mr. Hawtayne *re* the electric lighting scheme, and has fixed upon a suitable site for works, with convenient railway access and water supply. Trams may be worked from this generating station eventually.

Portsmouth.—A local paper says that the Electric Lighting Committee will shortly present a balance-sheet, showing a balance on the year's working of about £2,000. But at the present time the Committee are considering a complaint from the Postmaster-General that the wires interfere with the working of the Government telegraphs, and the suggested remedy would entail an expenditure of nearly £5,000 It is obvious, therefore, that the profit cannot at present be applied to the relief of the rates.

Salford.—Mr. F. A. Wilkinson, of London, has been appointed assistant electrical engineer for the borough of Salford at a salary of £160 per annum. On the recommendation of the Electric Light Committee the Corporation have decided to lay a new main to supply the Eccles Old Road district in place of the present defective one. It was decided that plant be put down at the new generating station proposed to be erected in Strawberry Road, Pendleton, capable of developing 3,600 indicated horse-power to meet the demand for traction purposes; that five machines, of 750 kilowatt, equal to 1,200 indicated horse-power each, or an aggregate of 6,000 horse-power, be adopted to meet the immediate and future demand for lighting and power, exclusive of traction purposes; that Lancashire boilers be adopted, and that engines running at a speed not to exceed 100 revolutions per minute be adopted.

Salisbury.—A member of the Council has postponed for the present a proposed motion that the Council buy over the electricity undertaking.

Sandown (I.O.W.).—The District Council recently received from the Board of Trade a draft provisional order, proposed to be granted to a company. The Council has replied, making several observations.

Sheffield.—In a recent report to the Station Sub-Committee by Mr. Johnson, manager and engineer at the electric light works, he says:—

When the machinery which is now being erected in the station is completed and in working order, there will be a total machine capacity of 2,300 kilowatts, capable of sustaining at full brilliancy 88,000 16-C.P. lamps. Owing to the conditions of the division of supply amongst the various circuits and districts, it is not desirable to calculate upon a useable capacity of more than 1,900 kilowatts, which will sustain 82,500 16-C.P. lamps. The possible demand upon the machinery for current at the moment of making this report is equal to 40,766 16-C.P. lamps, that being the equivalent number of lamps already connected to the supply mains. By the end of this year the number of lamps connected may have increased equal to 50,000, especially if public lighting is taken up by the Corporation in the manner I have suggested elsewhere. Experience has shown that the maximum demand for current during the heavier parts of the months of December and January occasionally reaches 60 per cent. of the total number of lamps connected. If by the end of this year the maximum demand should reach 50,000 lamps, 60 per cent. of that number will be equal to 30,000 lamps, whilst the useable capacity of the machinery is equal to 82,500 lamps. I am, of course, assuming that the machinery which is now being erected by the Brush Electrical Engineering Company will perform all the promises that have been made on its behalf. The design of this machinery, however, is a departure from the ordinary English practice, and the results of its trial runs are awaited with considerable interest. If either that machinery or any of the other machinery should fail in any way (I do not anticipate anything of the kind; but in electrical machinery the unexpected sometimes happens) then the station may be somewhat pinched to get through the requirements of Christmas time. The station has not at any time been in the possession of machinery sufficient to meet extraordinary contingencies, owing, firstly to a difficulty in obtaining suitable machinery from the limited sources of supply, which difficulty was accentuated by the recent engineers' strike; and, secondly, to a reluctance to order more machinery than was absolutely necessary to serve for the time being, owing to constant improvements in design, due to extended experience, and especially as these improvements have invariably provided more mechanical and electrical stability, and greater economy in the production of current. Perfection in construction of machinery has probably not even yet been arrived at; but there is less need for hesitation, and as the demand by the public for electric lighting continues to increase, the time has come when additional machinery should be ordered. The machinery now being erected by the Brush Electrical Engineering Company, Limited (if all turns out well) will occupy a distinguished position among electric lighting plants; but it will be some time before it is ready, and I shall require to carefully observe its performance under all possible conditions of working, before undertaking to advise the Committee in respect of it. Quotations have been obtained for further machinery, and which it is desirable should be of one or other of the types already in use here. The quotation by Messrs. Ferranti, Limited, for the delivery of a 1,000-kilowatt steam alternator for £9,500 is the lowest by a considerable sum. About 1,500 horse-power of machinery, made by Messrs. Ferranti is already fixed in the Sheffield electric lighting station, and it has given satisfaction. Acting on the instructions of the Committee, I have recently inspected machines of smaller size than 1,000 kilowatt, of Messrs. Ferranti's manufacture, in use at Derby and Hanley, and a larger size at the Bankside station of the City of London Electric Lighting Company. These machines carry improvements in details upon the 1896 type of Ferranti machinery in use here, and still further improvements upon all the above-mentioned machines have been incorporated in a specification which has been settled by Messrs. Ferranti and myself, and which are included in the price quoted. A steam alternator of 1,000 kilowatts will supply current sufficient to incandesce 17,000 16-candle-power lamps; it will require 1,700 horse-power to work it, and I propose that it shall stand in the new extension of the station. Messrs. Ferranti will contract to have the plant running by the beginning of December next, if it is ordered at once.

Shrewsbury.—The Electric Lighting Committee is considering the question of reducing the charges for electric current.

Sleaford.—Mr. B. Smith, of Oswestry, prepared an electric lighting scheme for the District Council, the cost of which, including provisional order and site, is £5,164. The Council last week approved thereof and decided to apply for a provisional order and for power to raise the necessary loan.

Stanford-le-Hope.—The contract for supplying the village with electric light having fallen through, a public meeting is to be called to consider the question of gas supply.

Stirling.—The laying of the electric light cables has been commenced by the Callender Company.

Stonehouse.—The Works' Committee does not advise the Council to further entertain the proposal of the English Industrials, Limited, *re* electric lighting at present.

Stretford.—Mr. John Roberts, the chairman of the Council, has been appointed chairman of the Electric Lighting and Tramways Committee, and Mr. Philip Estcourt, deputy chairman, for the ensuing year.

Uckfield.—The Rural Council has received a letter from the Board of Trade stating that the application for a provisional order in the matter of Crowborough electric lighting would not be proceeded with.

Vienna.—It is stated that the municipality is about to erect electric light works, for which a loan of 15 million florins has been agreed to, to cover the contract.

Walsall.—At Monday's Council meeting it was reported that the total number of electric light consumers supplied on April 30th last was 141. The total number of units generated at the station during the month was 10,835, and the machinery had been run, and when the undertaking paid the advisability of a further reduction might be considered.

Wellingborough.—The Highway and Lighting Committee recommends the Council to adopt Messrs. Horsfall's refuse destructor, and to ask them to prepare complete plans and estimates with a view of adopting the system in connection with a future supply of electrical energy.

Wolverhampton.—The Town Council on Monday resolved that to consumers of electrical energy to the extent of 30,000 units annually and upwards the charge shall be at a uniform rate of 3½d. per unit, and that any previous resolutions of the Council which may be inconsistent herewith be rescinded or varied accordingly.

Worksop.—The Council has decided to appoint an electrical engineer to prepare an electric light scheme. It is thought necessary to take time by the forelock.

Yarmouth.—The Town Council on Tuesday referred back to the Electric Lighting Committee a recommendation to spend an additional £27,000 upon plant, in order that Mr. W. H. Preece, the Council's consulting electrician, may submit a report.

Yeadon.—The District Council last week had before it various communications *re* electric lighting and tramway proposals. One was from Messrs. Alfred Dougill & Co., Leeds, who wrote that they were appointed by a wealthy syndicate to negotiate for tramway concessions in Yeadon and district. They would allow the District Councils and people in the district to co-operate in providing the capital, or they would provide the whole, and as an earnest of good faith, were prepared to deposit £10,000. Mr. W. W. McLauchlan, of Manchester, also wrote that he represented a company who would be willing to put down plant for the district for the purpose of electric lighting and also erect a tram system for Yeadon, Menston, and Guiseley, and extend the same to the Leeds boundary tramways. The clerk said Mr. Spink, a Leeds engineer, had also told him a London firm were wishful to take this matter up. It was decided to call a joint meeting of the Horsforth, Rawdon, Yeadon, Guiseley and Menston Councils to discuss the question. At the same meeting the question of extending the Yeadon Council's provisional order for electric lighting to Guiseley and Rawdon, will also be discussed with those two authorities.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Alloa.—At a meeting of the Burgh Commissioners this week proposals were submitted by Mr. Lea, superintendent of the British Electric Traction Company, for the construction of electric tramway between Tillicoultry and Alloa with a local line between Cambus and Clackmannan. Mr. Lea also stated that the company would be prepared to arrange for the supply of electricity from Alloa. The Gas Commissioners proposed the installation. Provost Grant said the proposals would be carefully considered.

Ashton.—The first electric car was run on 28th ult. from Denton to Ashton. On 3rd inst. a trial run was made from Denton to Gee Cross.

Bristol.—It is stated that the work of preparing the electric track between the Drawbridge and Totterdown and the Old Market Street and Temple Meads and Totterdown is so far completed that the standards would soon be in position, and the electric traction would commence by July 1st, these sections being worked by current from the St. George station.

Crewe.—The town clerk has received intimation from the Local Government Board that the order, after inquiry by the Light Railway Commissioners, for the construction of light railways or tramways at Crewe, has been withdrawn. The order for Crewe was amongst the first in the country, and was granted to the British Electric Traction Company.

Electricity for Indian Railways.—The *Times* says that Mr. Nethersole, Kashmir State engineer, has submitted a scheme for a railway from Jammu to Srinagar. He proposes to avoid the fuel difficulty by using the force of the Jhelum river to create electric power. The railway will be from 160 to 180 miles long, and will, it is estimated, earn profits of 8 to 13 per cent. India commends the scheme to the Durbar, offering the loan of surveyors and engineers, but taking no financial responsibility.

Frome.—The question of electrically lighting the town has been revived on the report of a sub-committee, who had visited Messrs. Butler & Tanner's works in the town. On its being decided to formally thank Mr. Tanner for the invitation, Mr. Seward said he did not want the question shelved. If, as someone said, the town was not ripe for the matter, he maintained that it was ripe enough to be considered.

Giant's Causeway.—The Giant's Causeway, Portrush and Bush Valley Railway and Tramway Company expect to be able in June next to commence using the overhead system. The poles have been erected along the line between Portrush and the Causeway, save for half a mile.

Glasgow.—Engineering and boiler making firms have memorialised the Town Council with reference to the proposed height of the trolley wires. They emphasise the necessity of placing them at least 26 feet from the road surface (instead of 20 feet 6 inches as at Springburn). An 18 feet 6 inches diameter boiler placed on a 4 feet carriage requires a clearance of 22 feet 6 inches, and then allowance has to be made for even larger sizes and also for possible sagging of the overhead wires.

Hastings.—It is stated that Lord Loch's Committee of the House of Lords have thrown out the Hastings Corporation Tramways Bill, the object of which was to enable the Corporation to construct tramways in the borough and to work them by electricity. Several doctors testified that the introduction of electric tramways into Hastings would have a disastrous effect on the place as a health resort.

Hull.—Messrs. Turner, Heason & Mitchell, of Manchester, have withdrawn their tender (£19,933) for the construction of the new electric tramway along Holderness Road, because of an error in the estimate. The Council has allowed this to be done and will do the work itself. The city engineer's estimate was £21,830, whereas the next lowest tender was £24,272.

Isle of Thanet.—The Earl of Jersey and his colleagues on the Light Railway Commission evidently do not believe in wasting time. Last week they were holding an inquiry at Westgate-on-Sea into the Thanet light electric railway scheme. The proceedings were somewhat drawn out, and after the inquiry had gone on for about three hours, the Earl announced that there would be no adjournment for luncheon, as he and his colleague, Colonel Boughey, were anxious to finish the inquiry that day. This announcement, says an evening contemporary, caused some uneasiness amongst the numerous counsel and solicitors in attendance. But the Earl, undismayed, produced a package containing sandwiches and also a flask. From the latter he took furtive draughts, at the former he made surreptitious nibbles. A witness was testifying to his objection, as a Westgate inhabitant, to the town being invaded by "common excursionists" from Margate, who would, he said, be brought over in thousands if the tramway was made.—Mr. Cyril Dodd, Q.C., for the tramway promoters, asked what he meant by common people.—"Oh," said the witness, "people who come down to Margate for the day and bring their food with them." This naive remark caused great laughter, and Lord Jersey, who was still at the sandwiches, narrowly escaped choking.—Mr. Dodd pressed the point further. "I take it, then," he said, "that it is the mark of a low-class person that when he comes to the seaside he brings his food with him?"—The witness apologetically explained that he was not referring to visitors who came to the seaside on tramway inquiries. The hungry counsel were avenged.

Italy.—The Rete Mediterranea Railway authorities have completed the plans for the projected conversion of the railway between Milan and Laveno into an electric line. The third-rail system is to be adopted, the electrical energy being supplied by the Società Lombarda del Ticino at a pressure of 10,000 volts, transformers along the line reducing this to 700 volts. The maximum speed has been fixed at 56 miles per hour for passenger trains and 24½ miles for goods trains.

Kingston.—At the Town Council meeting last week it was reported that the London County Council had written intimating their intention to construct a line of electric tramways from Wandsworth over Wimbledon Common, and through Kingston Vale into Kingston borough. The Council had replied, stating that they had a scheme of their own in hand, in answer to which London had expressed willingness to co-operate.

Kinver and Kingswinford.—The British Electric Traction Company are pushing forward with the construction of their Kinver tramway. Within the next few weeks, and possibly before May is out, they hope to start with the Kingswinford line, which will connect that neighbourhood with Dudley and Stourbridge by junctions with the existing tramway between those two towns.

Leeds.—Last year the net profit made by the Corporation on the working of the city tramways—that is, for the financial year from March, 1897, to March, 1898—was £5,449. This year, says the *Yorkshire Post*, it will not be less than £20,000. Last year the whole of the net profit was absorbed by the sinking fund charges, a nominal balance of £144 only being left to the credit of the account. This year, although the sinking fund charges will be nearly double those of 1898, there will probably be a surplus of something like £12,000. This is practical demonstration that the electrical section has made a handsome contribution to the profit of the year. The receipts during the year just ended, which amounted to no less than £114,000 as against £73,000 in 1897-8, an increase of 56 per cent. To this increase in receipts all classes of cars have contributed, those of the horse and steam routes having risen from £59,000 to £64,000, and those of the Roundhay and Kirkstall electrical line from £12,600 to no less than £48,000. It is to be borne in mind that on the horse car routes there have been material reductions in fares during the year. The £ s. d. of electric traction has yet to be worked out on both sides of the account, but in the face of the enormous receipts, which can hardly be less than 1s. per car mile, it is impossible to doubt that so far as the Roundhay and Kirkstall line is concerned the electrical system is paying handsomely. It was estimated a year or two ago that the cost of the electric service might amount to 7d. per car mile. If this estimate has not been exceeded there is clearly ample margin for depreciation and interest and sinking fund charges, with a probability that there will remain a clear profit of 1d. or 2d. per car mile run.

Lincoln.—The Electricity Works Committee last week reported to the City Council that they had inspected certain localities of the city and instructed Mr. Vesey Brown to prepare rough sketches showing three schemes for laying down tramways to be worked by electric power and to report to a future meeting, with estimates of the capital required. They instructed the engineer to commence the laying of cables on Monks' Road after May 14th. The committee had accepted the tender of Messrs. Foster & Co. for the supply of steam piping and valves, and that of Messrs. S. and R. Horton for extending the foundations at the works.

Liverpool.—The Council last week passed the following recommendation of the Tramways Committee:—

That side poles, with span wires or side wires, as the engineers may determine, be substituted for centre poles in Croxteth Road, and that the resolution of the Works Sub (Tramways) Committee of January 13th, 1899, confirmed by the Council on February 1st, 1899, approving of centre poles, be varied accordingly.

Lowestoft.—Ratepayers do not like the prospect of the proposed electric tramway passing along the Marine Parade. They met the other day and asked the company to modify the route and avoid the Parade.

Mumbles.—At a special meeting of the Mumbles Railway and Pier Company held on Monday, Sir John Jones Jenkins, who presided, explained that the chief object of the meeting was to sanction the action of the directors in abandoning a section of the old line between the Elms and Blackpill, in accordance with an undertaking given to Parliament when powers were obtained to construct the new line parallel with it on the foreshore. In getting this through Parliament they had several objectors, but they had settled, and he thought they had settled well in the interests of the company to lease the railway to the Swansea Tramway Company. That company has now been taken over by the British Electric Traction Company, and that company having running powers over the Mumbles line the directors were advised by their London agents and counsel that it would be desirable to let their line to the Traction Company. Mr. Strick (the solicitor) read the terms of the agreement.

Musselburgh.—The Parish Council having been asked by the promoters of the light electric railway which is to be run through Musselburgh to pass a resolution of approval, has appointed a special committee with powers to support the scheme if found beneficial to the community.

Newcastle.—On 8th inst. Mr. Hopkinson attended the meeting of the new Tramways Committee, and he was appointed consulting engineer for laying down the new tramways. A resident engineer will be appointed at £500 a year. Mr. Hopkinson reported having seen Prof. Kennedy since his return from America. The Professor is still anxious to visit Brussels, where the overhead trolley electric system worked conjointly with a small section of the conduit system. As soon as Prof. Kennedy has seen this, and gone into the whole of the details, he will, Mr. Hopkinson indicated, be prepared to report to the Newcastle committee, and advise them what to do in laying down a system in the heart of Newcastle.

Nottingham.—It is stated in a local paper that the visit to America of the city engineer and resident electrician "proves very clearly that the Tramways Committee, which once expressed itself as in favour of the clumsy overhead traction, has since then, from the individual experience of its members abroad, come to the conclusion that there are other systems equally deserving of consideration."

Oldham.—The Surveyor's and Tramways Committee recently informed the Hematite Steel Company, Limited, that their tender for tramway rails had been accepted, subject to the Council's confirmation.

Plymouth.—So confident is the Council of the ultimate success of the electric traction and electric lighting undertakings, that large extensions are already projected. The installation now approaching completion provides for the lighting of the streets in the business quarter of the town and the equipment of one section—the Prince Rock route—of the Corporation tramways. The Tramways Committee are anxious that electric traction should be applied to the other main section of their system and that between the Market and Compton. A report by the borough surveyor (Mr. J. Paton) and the electrical engineer (Mr J. H. Rider) states that this section has a total length of 1 mile 29 chains, of which rather less than three-fourths is double. A good deal of it will have to be reconstructed and the whole length will have to be bonded. The cost of this is estimated at £6,870, while the cost of the overhead electrical equipment is put at £3,210, and of 12 motor cars at £7,920, a total of £18,000. If this section as well as the Prince Rock section is worked by electricity, it will be possible to reduce the cost of current from 3·5d. to 2 3d. per unit. It is calculated that on the Compton section the necessary service will be equal to 287,376 car-miles, and the consumption of electrical energy 431,064 units. This works out to 5·3d. per car-mile, but as the cars will be larger than those now in use, an electric car-mile is equal to at least 1½ times a horse car-mile, so that the actual comparative cost is only 3·4d. Interest and sinking fund on the capital outlay will absorb £990 per annum, or ·83d. per car-mile, but against this is the saving on the cost of current on the Prince Rock section, which is put at £750. The manager of the tramways estimates that the gain by the adoption of electric traction on the Compton route will be £4,023 per annum. If the Town Council sanction the expenditure the scheme is to be proceeded with as quickly as possible. At present the tramways do not pay, mainly because of the excessive cost of horse traction on the Compton route, on which there are two long and steep hills.

Preston.—The Streets and Buildings Committee last week considered the offer of a company to take over the tramways from the Corporation and substitute a service to be worked by the overhead trolley system of electricity. It was announced that it was the intention of the company to extend the tramway to Lytham on one side and to Blackburn on the other, thus connecting Blackburn, Accrington and Darwen with Preston, Lytham, Blackpool and Fleetwood. The Committee referred the matter to the leading corporate officials and a sub-committee to report upon.

Southport.—The report of the Southport Tramways Company, Limited, says that in consequence of the arrangement made with the British Electric Traction Company, Limited, the majority of the shareholders have sold their shares to that company. A Bill has been promoted in Parliament by the company to authorise the adoption of electricity as a motive power on the company's lines, but the Corporation have not given their assent there, although, says the report, they suggested in the first instance that the company should obtain such powers.

Spen Valley.—Following upon their decision to oppose the scheme of the British Electric Traction Company, the authorities of the Spen Valley have decided to submit to the Light Railway Commissioners a joint alternative proposal for the construction of a tramway. Dewsbury, Heckmondwike, and Cleckheaton District Councils have, after a lengthy discussion, provisionally decided to join hands. The Liversedge authority were not invited to join the combination, because they have already assented to the application of the company, with reservations on points of detail.

Stirling to Tillicoultry.—The British Electric Traction Company has entered upon the preliminary stage of a scheme for constructing an electric tramway from Stirling to Tillicoultry by way of Craigmill, Blairlogie, Menstrie, and Alva. The company are endeavouring to acquire the Stirling and Bridge of Allan tramways, with a view to introducing a complete system of communication between Stirling and Bridge of Allan, and also the whole of the Hillfoots district.

Sunderland.—By the passing of the Sunderland Corporation Tramways Bill by Committee last week, the Corporation has succeeded in obtaining powers to work the trams and use electrical traction.

Sutton Coldfield.—A scheme is being promoted in Birmingham, having for its object the construction of an electric tramway, on the overhead trolley system, to Sutton Coldfield. Plans have been prepared by Messrs. Pritchard & Co, and it is proposed in the course of the present month to make application for a light railway order giving the necessary authority to carry out the enterprise. The proposed new line will practically be an extension to Four Oaks, Sutton, of the old tramlines which now run from the Old Square to the bottom of Gravelly Hill. The route of the new line will be that of the main road, through Erdington, Wylde Green, and Sutton, to a point near the cross roads close to Four Oaks station, on the London and North-Western Railway. The distance will be about 6 miles, and although there are several rather steep gradients, they are not considered of a character to occasion any difficulty. The entire cost of the undertaking will be upwards of £70,000.

Vienna.—The *Financial Times* Paris correspondent says:—"The financial event most talked about just now on the Vienna market is the approaching conversion into a public company of the well-known German firm of Siemens & Halske, which has secured the monopoly for the Viennese electric tramway system. The Austrian banks have, it is said, already subscribed the whole of the capital of the new company."

Walton-on-Naze.—A correspondent writes:—"The pier electric tramway is now completed, and Col. Yorke subjected it to the usual Board of Trade tests on Thursday last week, after which he declared the tramway to be perfectly satisfactory. The line will be opened for traffic on the 13th."

Whitefield.—A deputation will wait upon the Bury Corporation with reference to a letter in which they state that they are applying to Parliament this session for powers to run tramways in the borough, and wishing to know whether the Council would be prepared to purchase its section and lease the same to the Corporation.

Wigan.—At last week's Council meeting Mr. Alderman Holmes, in moving adoption of the minutes of the Electric Lighting Committee, said they had reached a stage when the subject had to be very seriously considered. They were now proposing to ask the Local Government Board for sanction to borrow no less a sum than £90,000 for electric lighting purposes. Mr. M'Quaid said the first estimate they had before them was one for £20,000, and he would like some explanation as to why the amount had been increased so enormously. Mr. Alderman Holmes replied that they had to take into account the equipment of the tramways, as there was a proposal to municipalise them. The minutes were confirmed.

TELEGRAPH AND TELEPHONE NOTES.

Cables between Singapore and Hong Kong.—In the House of Commons on Monday Mr. Provand asked the Secretary of State for the Colonies whether an agreement was made on October 28th, 1893, between the Secretary of State for the Colonies of the one part and the Eastern Extension, Australasia, and China Telegraph Company, Limited, of the other part, for laying a second submarine telegraph cable between Singapore and Hong Kong; whether this agreement secured the company against competition and placed them in possession of a preferential right to any future contract or concession for laying further cables between Singapore and Hong Kong for a term of 25 years; and whether such agreement was ever presented to Parliament, if not, would he state the reason why? Mr. Chamberlain replied as follows (*Times* report):—An agreement was made on October 28th, 1893, between the Secretary of State for the Colonies and the Eastern Extension, Australasia, and China Telegraph Company for the laying and maintaining for 25 years at their own cost by the company of a second submarine telegraph cable connecting Singapore, Labuan, and Hong-Kong. The agreement contains the following article:—"Article 4. In consideration of the engagements entered into by the company in this agreement, and of the strict fulfilment thereof, Her Majesty's Government undertakes to secure the company against competition to the extent following, that is to say—Her Majesty's Government will not, during the term of this agreement lay, nor grant, nor permit to be granted, any concession or authority for laying any new submarine cables connected with Hong Kong, Singapore, or Labuan (whether in competition with the cables of the company or not) unless such new cables should, in the opinion of Her Majesty's Government, be found necessary in the public interest of Great Britain, Hong Kong, the Straits Settlements, or Labuan, or in the general interests of international telegraphic communication. Provided always that if it shall be decided that new cables are to be laid the company shall, all things being equal, have the preferential right to the contract or concession for laying the same. Provided that this article shall not prevent the Great Northern Company from repairing, renewing, or replacing any submarine cable connected with Hong Kong, and shall not prejudice or affect the existing rights of that company." The agreement was not presented to Parliament as it imposed no charge on the public revenue.

French Telegraphists.—Mark the benefits which poor depopulated France may confer upon her postal and telegraph staff! The following is a translation from the French *Bulletin Hebdomadaire des Postes, Télégraphes, &c*, of May 4th:—

REFORMS IN FAVOUR OF EMPLOYES WITH FAMILIES.

The National Alliance for the Increase of the French Population has lately delivered to the Minister a list of reforms in favour of those employés of Posts and Telegraphs burdened with families. The following are the proposals submitted:—

1. The allowance of a supplementary indemnity to those employés who rear two or three children.
2. Amongst employés of equal merit, those who have children should have more rapid promotion.
3. When boarding expenses are granted the allowance to be in proportion to the number of children.
4. Facilities in the shape of travelling at half fares to be given to the families of employés when changing place of residence.
5. Gratuities at the end of the year to be proportionate to the number of children.
6. Heads of families who have more than three children each to have the privileges accorded to sub-agents not requiring special qualifications.
7. Assistance to be given in cases of confinements.
8. Facilities to be given to the husband and wife, when they both are employed by the Administration, to have the same hours of duty.

The *Bulletin* concludes by remarking it will return to the subject of these reforms later, and adds that some of them seem to be of easy arrangement. It has been suggested to us that some much married men in this country might be very glad to see a similar appreciation of their services. We suppose any such proposal in other branches of labour would not receive a very happy reception from the trade unions. They would want more "Egalité" with their "Fraternité." We are also inclined to think that masters would not altogether appreciate the situation if a worthless sloven with a score of children were to receive as wages half as much again or twice as much as a hard-working childless man occupied next to him, their respective values to their employer being as 1 : 10. "Unto him that hath shall be given."

Cheap Telegraph Rates.—The *Times* says that Mr. Henniker Heaton called a meeting of the Imperial Telegraph Committee for yesterday afternoon in one of the House of Commons committee rooms. Sir Edward Sassoon, the chairman, was to preside, and the draft letter to Mr. Chamberlain was, if approved, to be signed. It asks the Secretary of State to grant an inquiry into the question of cheapening telegraph communication to all parts of the Empire.

The German-American Cable.—The *Times* Berlin correspondent says that the efforts of the firm of Felten & Guilleaume, of Mülheim on the Rhine, in co-operation with the Imperial Postal Administration and the leading German banks, have resulted in the formation of a German Atlantic Telegraph Company for the construction and working of the proposed direct cable between Germany and the United States. In 1896 a cable was laid between Borkum, one of the East Frisian Islands, and Vigo, on the north-west coast of Spain. This was intended to form a portion of the new trans-Atlantic cable, but it has been found that its connection with the Spanish telegraph system and with the lines of the Eastern Telegraph Company gives this Borkum-Vigo cable so much work that it cannot be further burdened with the trans-Atlantic communication. It is now proposed to lay a cable from Borkum to the Azores, where an intermediate station will be erected, and thence to New York. A Bill to permit the establishment of the station on the Azores has already passed the Portuguese Chamber, and it is hoped that the Senate will also give its consent. An agreement has been arrived at with the Commercial Cable Company and the Postal Telegraph Company by which these two American societies undertake to forward the messages of the German Atlantic Telegraph Company from New York to their destinations in America.

The Pacific Cable Scheme.—On May 5th Sir William Laurier received the following despatch from the Government of British Columbia:—"Fearing that Great Britain's departure from the original proposal would delay and thus defeat the Pacific cable project, the Province of British Columbia offers to contribute two-eighteenths of the cost in addition to the five-eighteenths contributed by the Dominion."

Ottawa telegrams report that the offer of British Columbia to contribute two-eighteenths of the cost of the Pacific cable, independently of the five-eighteenths to be provided by the Dominion as a whole, is contained in the following despatch to Sir William Laurier from the Finance Minister of the province:—"This Government observes with great regret that further difficulties have arisen in connection with the Pacific cable scheme. It regards the enterprise as of vast importance, and as absolutely necessary if Canada is to secure her proper share of Pacific commerce, which it believes will rapidly assume large proportions. Particularly is the enterprise of moment to British Columbia, the Dominion gateway to the Pacific. On these grounds this Government feels justified in assisting the realisation of the scheme beyond what is involved in its provincial share of the Dominion's responsibility. This Government, therefore, will assume for the province one-ninth of the cost of the cable on arrangements similar to those with the Australian Colonies, hoping that, in thus strengthening the hands of the Dominion Government, the consummation of this Imperial enterprise may be achieved."

The cabled synopsis of the correspondence on the Pacific cable question has (says the Ottawa correspondent of the *Times*) intensified the feeling of disappointment here at the action of the Imperial authorities. Sir Sandford Fleming has addressed to the newspapers a dignified letter, which reviews the situation. He says that the proposal of the British Government is of no value for securing the establishment of so important an Imperial work, and he cannot believe it to be the full or final judgment of the Home Government, for the following reasons:—

1. It will always be regarded as a recession on the part of the mother country from a common understanding with Canada, Australia, and New Zealand.
2. It will always be regarded as an attempt to retard the expansion, and cripple the commerce of the Empire in the interest of a few rich monopolists.
3. It will always be regarded by the people of Canada, Australia, and New Zealand as an unjustifiable and discourteous act to them.
4. Its effect will be far-reaching, and the immediate effect will be a fatal blow to the scheme for establishing a system of State-owned British cables encircling the globe.
5. It will be a very grave retrograde step in the Imperial movement, which aims at drawing closer the bonds between the mother country and her daughter lands.

Notwithstanding the changed attitude of the Imperial authorities, the Dominion Government will press its proposals before Parliament, and, with the cordial support of Sir C. Tupper and the Opposition, will place them in the Statute Books, leaving the responsibility for the failure of the enterprise to rest with the Home Government.

The question of the construction of the all-British Pacific cable is (the Central News learns) far from being shelved.

The Imperial Government and the representatives of the Colonies have been busily exchanging views.

A requisition from the Agents-General in London that the whole matter should be considered as still open for discussion, drew from Mr. Chamberlain an invitation for a statement of objections to the Colonial Office scheme.

At a meeting on Saturday, therefore, the Agents-General complied with the Colonial Secretary's wish, and it is believed that, as a result, some important modifications will be made.

Yesterday's *Daily Chronicle* says that an important letter, putting the views of the British Colonies actively interested in the all-British cable, was on Wednesday transmitted to Mr. Chamberlain. This document is in effect the reply of the colonies to the intimation made the other day by the British Government of its attitude towards the new cable scheme. It is signed by the representatives here of

Canada, New South Wales, Victoria, Queensland, and New Zealand. The three remaining Australasian colonies are less directly interested, but they give their general support to what is being done. It has been made quite apparent that Canada will not go forward with the scheme on the scant lines suggested by the Imperial Government. The view is this—that unless the Imperial Government is willing to do more than it has indicated so far, the whole scheme will collapse. What the colonies want, therefore, and what they are urging, is that the British Government should go hand in hand with the colonies in the whole undertaking. A rumour prevails that a certain cleavage of opinion has taken place within the Government as to the assistance which ought to be given to the carrying out of the cable scheme. At all events, it is asserted that Mr. Chamberlain would gladly see the utmost practical support given to the undertaking.

Yesterday's *Times* contains the following interesting paragraph from its Ottawa correspondent:—"A report from Victoria, B.C., says that Her Majesty's survey ship, *Egeria*, which is now there, has received orders to prepare to take up survey work in connection with the Pacific cable."

Submarine Cables to the Netherlands.—The *Times* says that a recently issued Parliamentary paper contains the text of a Convention between the United Kingdom and the Netherlands, providing that submarine cables connecting the two countries shall be their joint property. The Convention was signed at the Hague on April 5th, 1898, and ratifications were exchanged at the Hague on December 13th, 1898. An agreement between the postal authorities of the two countries respecting telegraphic correspondence over the direct submarine cables is annexed. By this agreement the charge for the exchange of ordinary telegrams is fixed at 2*d*. per word in the United Kingdom, and 10 cents in the Netherlands, the respective *minimum* charges being 10d. and 50 cents per telegram.

The Telegraph Wire Export Trade.—The returns just issued relating to the exports of telegraph wire and apparatus connected therewith from this country during April last show that this trade is just now rather quiet, the value for the month only attaining a total of £49,719, which compares with £64,883 in the corresponding month of last year and £75,688 in April, 1897. Owing to the activity, however, which prevailed in the early part of the year, the exports for the first four months show an increase over the past two years, the total being £442,479, as against £313,671 in the corresponding period of 1898, and £321,160 in the first four months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
Eastern Telegraph Co.'s cable—		
Ilo Ilo-Bacolod	May 5th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Landlines.		
Communication between Mossamedes and all Inland Offices.	March 16th, 1899 ...	...
Communication between Salonique and Monastir.	March 23rd, 1899 ...	...
Line between Antofagasta and Cochabamba (Bolivia)	May 9th, 1899 ...	...

The Telephone Question.—On 5th inst. the Chancellor of the Exchequer received a deputation from various Corporations and other local authorities who supported a memorial in favour of the Mutual Telephone Company's receiving a telephonic licence in Manchester. In reply, he reviewed the circumstances which had led the Government and the House of Commons' Committee of last session to come to the conclusion that no more licences to companies ought to be granted, and expressed the opinion that the best course would be for local authorities themselves to apply for licences under the provisions of the Government Bill. He could do no more than promise careful consideration to the views laid before him by the deputation.

Tunbridge Wells Telephones.—The Council has decided to experiment at the Town Hall "with the new system of the Telephone Construction Company, who had offered to instal an experimental telephone exchange upon their automatic principle."

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—June 7th. The Vestry wants tenders for the supply of mains, water-tube boilers, steam dynamos and engines. See "Official Notices" April 14th.

Bexley (Kent).—May 31st. The L.C.C. Asylums Committee is wanting tenders for the installation of telephones, fire alarms, tell-tale clocks, and call bells at the Heath Asylum, Bexley, Kent. Instructions, &c., can be obtained from Mr. R. W. Partridge, clerk of the Asylum Committee, 6, Waterloo Place, S.W.

Birkenhead.— May 26th. The Corporation wants tenders for the supply and delivery of 100 electric meters. See "Official Notices" May 5th.

Blackpool.—May 20th. The Tramways Committee wants tenders for ten bogie tramcars. See "Official Notices" May 5th.

Brighton.—May 29th. The Council wants tenders for the supply of auxiliary switchboards and switchboard gallery at the electricity works. See "Official Notices."

Crewe.—June 1st. The Corporation wants tenders for boilers and economisers, engines and dynamos, centrifugal pump and motor, mains, battery, switchboard, and travelling crane. See "Official Notices" May 5th.

Ealing.—May 15th. The Ealing Council is now inviting tenders for two boilers with superheaters and accessories, as may be ascertained on reference to our "Official Notices" for April 21st.

Ealing.—May 15th. The Council is inviting tenders for steam, exhaust and other piping, &c., switchboard and connections, &c. See "Official Notices" April 28th.

Edinburgh.—May 15th. The Corporation wants tenders for the supply of copper strip for electric conductors. See our "Official Notices" April 28th.

Edinburgh.—May 22nd. The Council wants tenders for two steam driven fans for induced draught. See "Official Notices" May 5th.

Enniskillen.—May 22nd. The Urban District Council invites tenders for supplying and fitting up gas engine, dynamo, and complete electric light installation for lighting New Town Hall, Enniskillen, according to plans and specifications prepared by Messrs. Anthony Scott, M.S.A., and Wm. A. Scott, A.R.I.B.A., architects, and which can be seen at their office, 16, William Street, Drogheda, or at the Town Clerk's office, Enniskillen.

Fleetwood.—May 16th. The District Council wants tenders for lamps and lamp-posts for street arc and incandescent lighting, and also for wiring, switchboards, lamps, &c., for the Town Hall, Free Library, Market, and Slaughter House lighting. See "Official Notices" April 28th.

France.—May 18th. The French Post and Telegraph authorities in Paris are inviting tenders until the 18th inst. for the supply of 225 kilometres of paper insulated electric cable. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Glasgow.—May 17th. The Corporation wants tenders for the supply of carbons and rubber covered insulated cables for one year from 31st inst. See "Official Notices" this week.

Hackney.—June 13th. The Vestry invites tenders for trenching, troughing, cables, joint boxes, jointing and house services. See "Official Notices" May 5th.

Halifax.—May 26th. The Corporation wants tenders for 100 tons of 2-inch and 2½-inch cast-iron pipe. See "Official Notices" this week.

Hampstead.—May 18th. For the purpose of extensions at the electricity works, the Vestry wants tenders for two 500-kw. steam alternators, five switchboard panels, boilers, feed water heaters, Weir's feed pumps, a 50-kw. exciter, water softening plant, air pump and condenser, Green's economiser and overhead crane. See "Official Notices" April 7th.

Islington.—June 1st. The Guardians of the Poor of St. Mary, Islington, invite tenders from persons prepared to carry out the necessary works for the installation of the electric light at the New Infirmary for the Parish at Highgate Hill. Further information, copies of plans, &c., from Mr. W. Smith, architect, 65, Chancery Lane, W.C.

Kertch.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Taganrog, stating that tenders are invited by the municipality of Kertch for the supply of materials for the construction of electric lighting plant and tramways in that town.

King's Lynn.—May 15th. The Corporation wants tenders for electric wiring and fittings for the Municipal Technical School. See our "Official Notices" April 28th.

St. Pancras.—May 16th. The Vestry wants tenders for additional engines, dynamos, &c., at the Regent's Park Station. See "Official Notices" April 21st.

St. Pancras.—May 23rd. The Vestry wants tenders for about 22 miles of lead-covered armoured cables. See "Official Notices" this week.

Southampton.—June 5th. The Corporation wants tenders for motor cars and equipment, and the electrical equipment of lines. See "Official Notices" this week.

Southport.—May 17th. The Electricity Committee is inviting tenders for a C.I. tank, a centrifugal pump, and electric motor. See our "Official Notices" May 5th.

Teneriffe.—June 14th. Tenders are being invited until June 14th by the Spanish Ministry of Public Works in Madrid for the concession for the construction and working of an electric tramway between Santa Cruz de Teneriffe and San Cristobal de la Laguna, Teneriffe. Tenders to be sent to La Direccion General de Obras Publicas (Ministerio de Fomento), Madrid, whence particulars may also be obtained.

(*Continued on page* 777.)

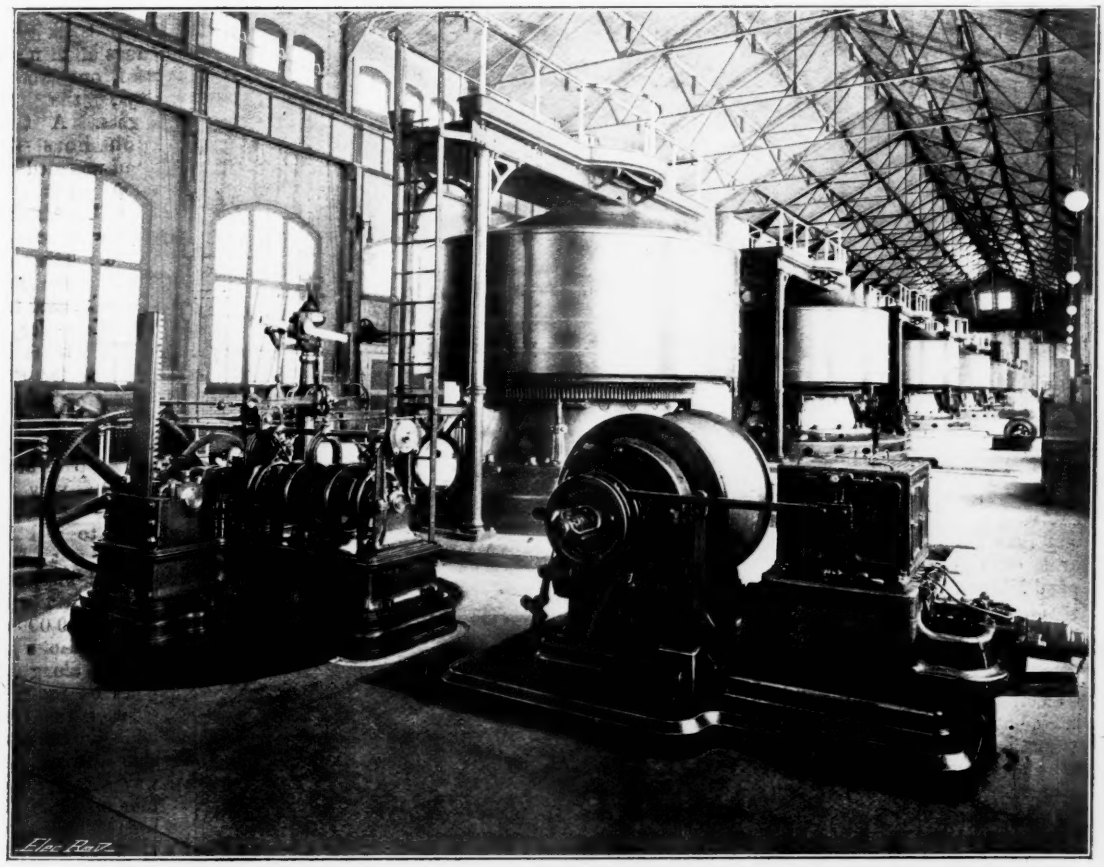
NIAGARA POWER FOR BUFFALO RAILWAYS.

By ORRIN E. DUNLAP.

The Buffalo and Niagara Falls Electric Railway and the Buffalo and Lockport Electric Railway are now both operated entirely by power generated in the central station of the Niagara Falls Power Company at Niagara Falls. This result has been attained by the construction of a new transformer station in North Tonawanda, from which current is supplied to both of the electric roads referred to. Current is also supplied to the Buffalo line from the central station at Niagara Falls and to the Lockport road from a station in Lockport. In the past, the Buffalo and Niagara Falls road has maintained a power station in Tonawanda for supplying the Buffalo end of its line, but now this station is about to be dispensed with. When running over the tracks of the Buffalo Railway Company in the city of Buffalo, the power for their operation is supplied from the Buffalo Railway Company's station on Niagara Street.

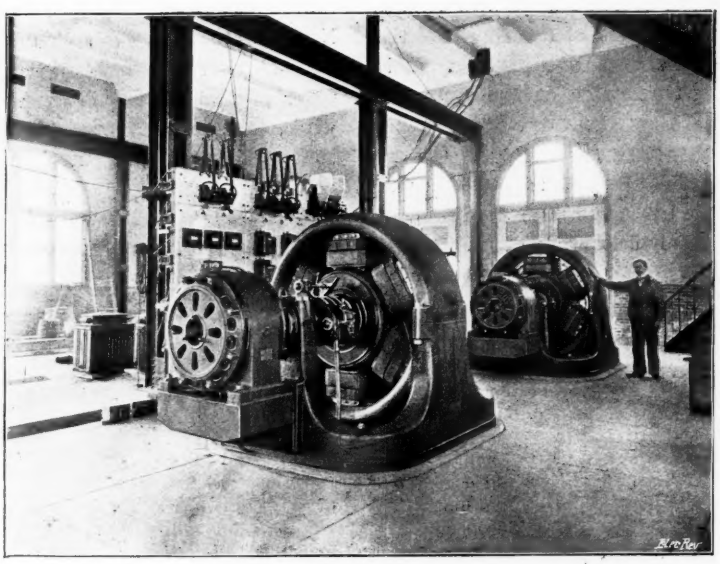
Ever since the Buffalo and Niagara Falls road was constructed, it has been the hope of the promoters to operate it entirely by Niagara power, but the delay in getting the stations in readiness has prevented this result until now. The fact that these two great electric trunk lines are operated between two cities so intimately connected in power matters, as are Buffalo and Niagara Falls, is a most important condition, considering the rumours that prevail in the Niagara region to-day, that the men who are interested in the Niagara Falls Power Company are also about to become interested in the great $25,000,000 syndicate, which it is stated will control all of the electric roads in and between the two cities on the western border of New York State. Should this statement prove to be thoroughly accurate, it will mean that the men of the great power company at Niagara have purchased the electric lines in order to make thoroughly sure of a well-paying customer for a part of the power they will develop in their power station. In other words, they will then secure for themselves the profit of both producer and consumer, which in this case is likely to prove considerable.

To-day the Cataract Power and Conduit Company are the distributing agents for Niagara power in the city of Buffalo, and recently the Tonawanda Cataract Power Company has been organised for the purpose of distributing the Niagara current within the town of Wheatfield, North Tonawanda, Niagara County, and the town and village of Tonawanda, Erie County. The officers of this company are Charles A. Sweet, president; William B. Rankine, secretary and treasurer, and De Lancy Rankine, assistant secretary and treasurer. It is this company that has just completed its new transformer station on Robinson Street in North Tonawanda. The building is of brick, and stands close to the Buffalo-Niagara transmission line, from which the current for its operation is taken. The dimensions of the building at the foundation are about 60 by 80. The main floor of the building is undivided, and in the spacious room there has



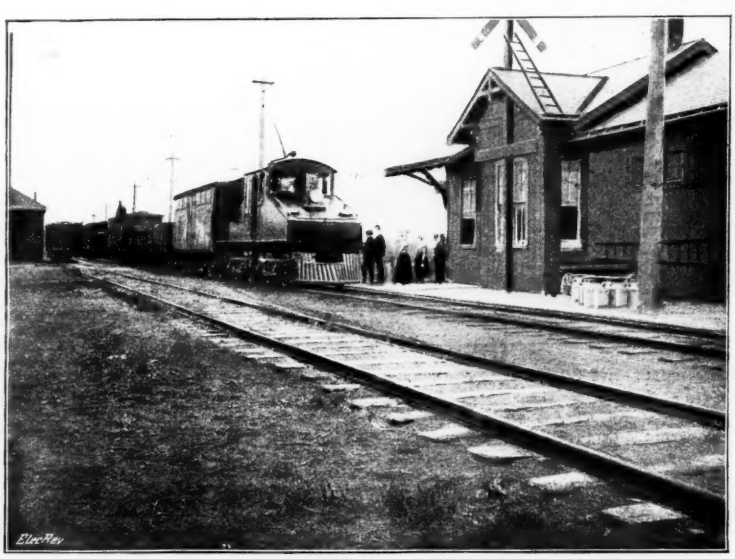
Latest View of the Interior of the Central Station of the Niagara Falls Power Company. Total Capacity 40,000 H.P.

been installed two 500-horse-power rotaries, four 500-horse-power static transformers, and the necessary switchboards. The installation was erected by the Westinghouse Electric and Manufacturing Company. The three-phase current from the transmission line enters the building on the east side, at a voltage of 11,000. It passes through high tension circuit breakers located in the second storey or attic, and then to the lower floor and the static transformers, where it is reduced to 375 volts, at which potential it goes to the rotaries. The static transformers are oil cooled. The present installation is located in the east half of the building, and room has been provided for two more rotaries and other apparatus. The west half of the floor is to be devoted to a lighting plant. The switchboard is of white marble, and has eight panels. Two of these are alternating current panels, one a feeder panel, and a panel for each of the rotary converters. There is also a panel for the alternating current, or primary board three-phase, and two panels for local distribution. Lightning arresters are also located in the upper storey. Two 12-ton cranes are operated overhead in the transformer room. N. F. Irish is the superintendent in charge. From this station the current is supplied to a point near Pendleton Centre on the Lockport road and to a point near the car barns on the Buffalo and Niagara Falls road north, and to the Buffalo City line on the south.



Rotary Converters in the Station of the Tonawanda Cataract Power Company.

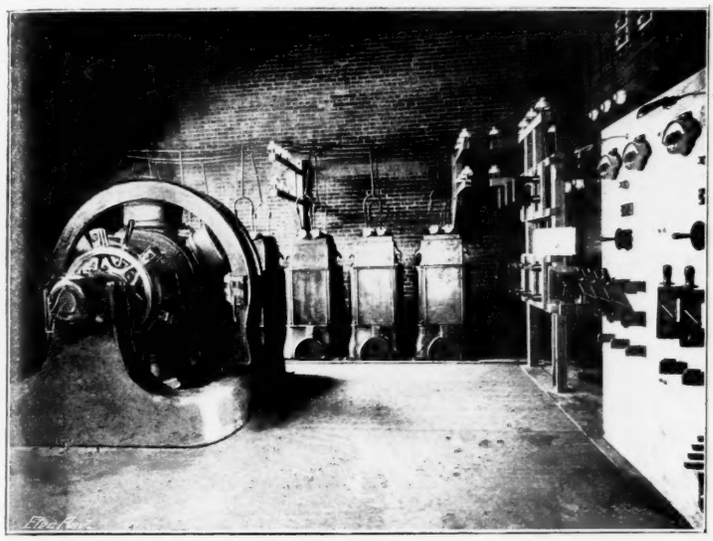
The erection of this latest transformer station is of particular interest, because it admits of more perfect operation of the Buffalo and Niagara Falls electric road and the Buffalo and Lockport road, of both of which Hon. W. Caryl Ely, who is recognised as the greatest living electric road promoter and builder in the United States, is president. It is to be recalled that the operation of the Buffalo and Lockport road marked the first surrender in Western New York of a former steam road to the onward march of electric traction backed by the great power development at Niagara Falls. The steam road thus acquired was the North Tonawanda-Lockport branch of the Erie Railway, and for all the company was incorporated on May 3rd, 1898, so great was the energy thrown into the enterprise that by August 15th of that year the steam road service, both freight and passenger, between North Tonawanda and Lockport, had been supplanted by the electric service, and the electric cars of the line ran into the city of Buffalo. When the Buffalo and Lockport Railway Company gained control, the old Erie track was in a fair condition, being laid with 60 lb. rails. It was found necessary to relay a mile of track a short distance out of Lockport, and on this occasion 80 lb. rail was used. The line thus secured by the lease is a single track having three turnouts or switches, the first of which is located about a mile west of Lockport; the second six miles and the third about 10 miles. In bonding the track two gangs of men were used, one working days, the other nights. A three-inch horse-shoe bond was used with 0000 wire under the rail. About 20 days were occupied in completing this work. The length of track leased from the Erie for 99 years is 13½ miles, and for nearly 12 miles the track is a straight line, affording excellent opportunities for speed between stations. The trolley wire is strung on a double line of poles, set 88 feet apart, excepting for about three-quarters of a mile in the Erie yards at North Tonawanda, where an arm support is used. The tops of all poles are 22 feet above the rail. The pole line presents a very neat appearance, the butts to a height of 6 feet being painted black and above that white. Three 500,000-cm. feeder cables are strung along the poles on the north side of the track, while on the south side of the right of way a power transmission line has been built, the Buffalo-Niagara transmission line being tapped at North Tonawanda. The poles of the transmission line are set 100 feet apart, and on a single cross-arm are carried three 0000 bare copper wires for the three-phase system of transmission. All the insulators used on this line are identical with those used on the Buffalo-Niagara line. In the reconstruction of the road the train service of the Erie was not so frequent as to interfere to any great extent with the working of the construction train and its crew. On the approach of an Erie train the construction train would take to a siding to await its passage. The construction train consisted of three flat cars, a caboose, and an engine. On one of the flat cars a 6-horse-power engine was installed to aid in handling the poles. In stringing the wire,



Electric Locomotive Used on Buffalo and Lockport Road.

it was run out from a boom on one of the cars at the rate of about five miles a day.

While there may be extensions in the near future, the total length of track operated by the Buffalo and Lockport Railway Company to-day is 29 miles, made up of 15½ miles owned by the company and 13½ miles leased by them. When the promoters of this line decided on its construction they purchased the Lock City Railway and its 5½ miles of track, and they now also own the Buffalo, Kenmore and Tonawanda Electric Railway and the Elmwood Avenue and Tonawanda Electric Railway. It has been intimated that the line would be double-tracked from North Tonawanda to Lockport, and also that it is to be extended to Olcott, on Lake Ontario, but as yet this has not come in the form of a definite announcement, for all both are among the probabilities. From North Tonawanda to Buffalo the cars of the Buffalo and Lockport road run over the tracks of the Buffalo and Niagara Falls electric road, an arrangement that is mutually beneficial, inasmuch as Hon. W. Caryl Ely is at the head of both roads, and in Burt Van Horn both roads have the same general manager.

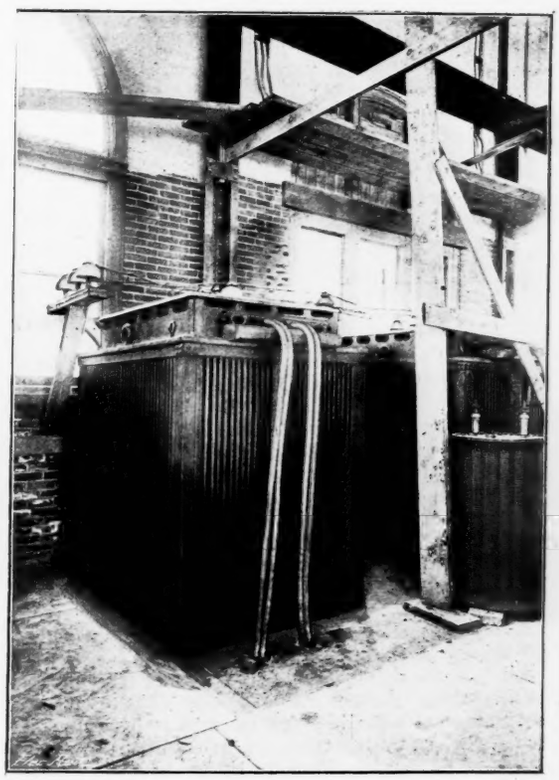


Interior View of Lockport Sub-station of the Buffalo and Lockport Road.

Power from the central station at Niagara Falls is now carried to the sub-station in Lockport at a voltage of 11,000, and there it passes into six 150-kw. static transformers of the type portrayed in the illustration. The pressure is thus reduced to 350 volts, at which it passes into the rotary converters, where it is changed to direct current at a voltage of 550. The rotary converters in this station are six-pole machines, making 550 revolutions per minute. A blower driven by a small motor furnishes the air blast for the transformers. This sub-station is located in the company's new car barn in Lockport, at the east end of the old Erie depôt.

One of the novelties that confronted the Buffalo and Lockport Railway Company when it leased the Erie branch was the necessity of providing for the freight as well as the passenger business of the line, but the company has proved itself equal to the occasion, and to-day is taking care of the freight business in a manner that shows that it is a cherished part of their income. To meet all the requirements both for passengers and freight, the company purchased 10 cars and two electric locomotives. Each of the cars weighs from 20 to 25 tons, and is equipped with four motors, each of 52 horse-power, and has B8 controllers and electric brakes. The colour of the cars is yellow, closely resembling the cars of the Buffalo and Niagara Falls road. The length of the combination passenger and smoking cars is a little over 42 feet over the buffers, and nearly 32 feet over the red panels. Their general construction conforms to both steam and electric road practice. A single step leads to the platforms, which are enclosed by vestibules. The platforms have also folding gates and hinged doors provided for them. The car windows are large, affording excellent facilities for viewing the scenery along the line. In the main compartments of the cars there are 14 reversible back seats, while the smoking compartment has six seats of the same pattern, affording accommodation for 12 people. All seats are of the woven cane variety. In this class of car the compartments are separated by a partition in which are glass windows at the sides of the sliding door. All the cars are provided with electric heaters. The length of the baggage and passenger cars are a little shorter than the cars referred to, being nearly 38 feet in length. In the passenger compartment there is accommodation for 28 persons. The baggage compartment is 12 feet long, a size sufficient, it has been found, to accommodate all baggage on the line. On each side of the car there is a sliding door through which baggage is received or delivered, and there is also a partition between the baggage and passenger compartments.

The electric locomotives of the company are the first placed in service in Western New York, and, therefore, have attracted unusual attention. They are of the same pattern as employed on the underground roads of London, England. The weight of each locomotive is about 40 tons, and each is equipped with four 55-horse-power motors. The height over cab is 12 feet, and the length of the locomotive is about 32 feet. The cab is centrally located, with a sloping shield on each side. Lockport is quite a manufacturing city, while North Tonawanda is one of the greatest lumber markets in the United States. Therefore a very large freight business fell to the Buffalo and Lockport Railway Company, and this they have handled very nicely. North Tonawanda is midway between Buffalo and Niagara Falls, and on the arrival of trains at the first-named station they are met by an electric locomotive, and the freight quickly transferred from



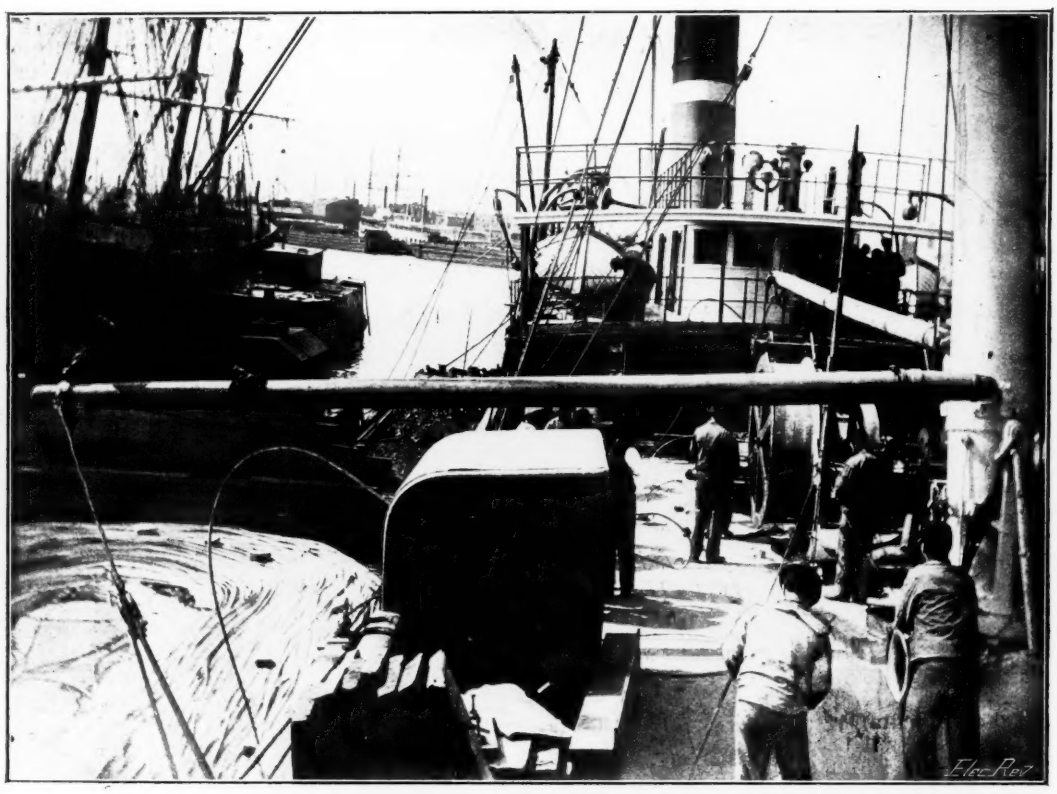
Static Transformers.

the steam to the electric road, the electric locomotive speeding off to Lockport with it at a rapid pace. It is a novel sight to see the little electric locomotive and the big steam monster working side by side, one snorting and puffing, emitting sparks and smoke, the other noiselessly going about its business. One of the valuable features of the company's rights in the city of Lockport is that its franchise allows it to run freight cars through the streets of the city between the hours of 11 p.m. and 5 a.m., which gives good opportunity of handling the freight of the mills with which the tracks are connected. Other connections are in contemplation. Having been used for steam road traffic, all the sidings of the company between North Tonawanda and Lockport are sufficiently long for freight trains. The electric locomotives have pneumatically-controlled trolleys, which removes the necessity of any of the crew of the locomotive leaving the cab to replace the trolley wheel on the wire, or to reverse it, the result in either case being effected by the operation of a handle in the cab. By simply admitting air into a cylinder, the downward motion is obtained, the piston of the cylinder pressing the spring that holds the pole in place when in use. Both the pole and the handle are on a swivel plate, and the upward motion is secured by the spring, and the movement to the side by the hand. Both of the electric locomotives are equipped with bell, air whistle, air brakes, sanding arrangement, &c. In the adjustment of the freight accounts between the Buffalo and Lockport road and the Erie road, the former is allowed a percentage of the total freight charge for handling the freight between North Tonawanda and Lockport.

Since the old Erie branch has been electrically operated, the people along the route have enjoyed a vastly improved service, for under the Erie *régime* there were but four trains each way a day, the passenger and freight business requiring the service of four locomotives. Under the schedule of the Buffalo and Lockport road there are 60 train units, 30 each way, and this excellent service is enjoyed by all sections of the line, not merely by the station stopping points as heretofore.

Cars are run every half-hour between Buffalo and Lockport, the total distance being 25 miles. The run from Lockport to North Tonawanda is made in 23 minutes, while from Lockport to Buffalo the time is 1 hour and 13 minutes. Considerable time is lost on the tracks of the Buffalo Railway Company in Buffalo, where the heavy traffic necessitates slower time. The cars of the Buffalo and Lockport line are fully capable of making 50 miles an hour. A feature of the electric road service, both on the Buffalo and Lockport road and the Buffalo and Niagara Falls line, is that the transfer system allows people to travel direct to their destination in any of the cities reached by the electric roads.

The summer travel and the freight traffic are the important means of support and earnings of the Buffalo and Lockport line, while on the Buffalo and Niagara Falls road the summer travel is always very heavy. This latter road does not handle freight. C. K. Marshall is superintendent of both roads.



U.S. Cable Ship "Hooker."

THE UNITED STATES CABLE SHIP "HOOKER."*

At Morse's shipyard, in South Brooklyn, the United States Army transport *Hooker*, No. 1, is being fitted as a cable ship for service in the Philippine Islands.

When the urgent necessity for connecting the various islands of the Philippine group by cables became evident, it was decided to fit this ship out as a cable vessel, she being the first craft of this type ever owned by the United States Government. Extensive alterations were made, nearly all of the interior fittings of the ship being removed, and three tanks for cables installed, as well as refrigerating rooms and appliances for the transportation of fresh meat. The forward cable tank is 13 feet in diameter and 8 feet high, and has a capacity for 60 tons of cable. The midships tank, 24 feet by 13 feet, has a capacity for 400 tons, and the after tank, 26 feet in diameter and 6 feet deep, will contain 240 tons, the total capacity thus being 700 tons of cable. These tanks are circular, and slightly conical in shape, and are built of boiler iron with calked joints, so as to be water-tight.

* An advance proof from the New York *Electrical Review*.

On the main deck forward is installed a winning gear, consisting of a drum of about 8 feet in diameter, supplied with brakes and the usual accessories for cable work. In the bows is a boom, carrying at its end a pulley over which the cable is paid out. The illustration shows very clearly the winding drum, and also a scow-load of cable lying alongside and being coiled into the forward tank. The men in the foreground are engaged in splicing on the new section of cable to that already in the tank. This view of the ship was taken from the forecastle, looking aft, and shows part of the new superstructure which has been placed upon the *Hooker*. Directly under the pilot house is the cable-testing room. Here are installed various instruments of precision, including high resistance Wheatstone bridges and sensitive Kelvin marine galvanometers.

The old electric light plant which the ship contained when captured has been removed and replaced by a new one, which consists of two 175-light units, each composed of a C and C dynamo direct-coupled to a Buffalo Forge Company's engine. The Vance Electric Company, of New York, installed all of this plant and the wiring, including two searchlights, which will be carried on the flying bridge forward.

It is expected that the *Hooker* will have a cruising speed of about 13 knots. She is 333 feet long over all, 33 feet beam, about 2,000 tons burden, and has an engine of about 1,600 horse-power working a single screw. In order to better fit her for cable service the forecastle has been heightened about 6 feet, giving her a high freeboard forward. On top of this forecastle are mounted two Hotchkiss six-pounder rapid-fire guns for use in the pirate-infested seas in which the ship's work will be done. The magazines for these guns are directly below them. In addition, the ship will carry about 75 stands of small arms. The complement of officers and men will consist of 150, Capt. C. L. Fenton, of the Quartermaster's Department, being in charge of the army force, while Captain S. J Hanlon is in charge of the navigation of the ship. The reconstruction of the vessel and its equipment for its new use has been under the direction of Mr. Gardiner C. Sims, supervising engineer for the army transport service. Mr. Sims will be remembered for the admirable work which he did aboard the United States repair ship, *Vulcan*, during the blockade of Cuba and after the sea fight at Santiago. It is expected that the *Hooker*, having on board 240 miles of cable, will sail for the Philippines about May 1st.

CONTRACTS OPEN AND CLOSED.

(*Continued from page 772.*)

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Aberdeen.—The Council has accepted the tender of Messrs. Babcock & Wilcox for the supply of boilers for the electricity works at £2,080.

Brighton.—The Lighting Committee recently accepted a tender from Messrs. Babcock & Wilcox for two water-tube boilers with fittings, &c., for £2,898. This price is £23 per boiler above the last contract owing to higher prices of metals and the great congestion in the engineering trade.

Derby.—The Electric Lighting Committee has accepted the tender of Mr. Henry Vernon for building and excavating work in connection with the extension of the engine and boiler houses. Tenders have been invited for transformers and the contract awarded on a schedule of prices for one year to the Electric Construction Company, Limited.

Dundee.—Messrs. Lowden Brothers, Dundee, have secured contracts to supply the Corporation with British-made engines and dynamos, the prices being £5,550 and £4,900 respectively.

Sheffield.—The Council has accepted the tender of Messrs. John Spencer, Limited, Wednesbury, for the supply of poles and brackets for the electric tramways, the prices, based on not less than 500 poles and brackets being ordered, being as follows:—Poles at £8 11s., £9 17s., and £14 3s. 6d. each, according to dimensions; brackets, from £3 15s. 6d. to £4 18s. each. The tender of the Electric Railway and Tramway Carriage Works, of Preston, has been accepted for the supply of 30 double-deck motor car bodies and trucks, with all necessary slipper brakes, scotches, and fittings, other than motor equipment; the question of what kind of truck is supplied to be left over for further consideration. The work of reconstruction of the tramlines on the Brightside and Heeley sections is to be commenced as soon as convenient. The proposed double junction in Ecclesall Road at the bottom of Hanover Street is to be omitted.

Sheffield.—The Town Council has given an order to Messrs. Ferranti for a 1,000 kw. steam alternator for £9,500. This machine will be equal to 17,000 16-C.P. lamps.

FORTHCOMING EVENTS.

Friday, May 12th.—At 9 p.m. Royal Institution. Discourse by Prof. T. Preston, M.A., on "Magnetic Perturbations of the Spectral Lines."

At 5 p.m.—Physical Society. "Note on the Vapour Pressure of Solutions of Volatile Substances," by R. A. Lehfeldt, D.Sc.; "Note on the Discussion of their Paper on the Criterion for an Oscillatory Discharge of a Condenser," by Prof. W. B. Morton and Dr. Barton; Exhibition of a Quadrant Electrometer by Mr. G. L. Addenbrooke.

Saturday, May 13th.—Institution of Electrical Engineers Students' visit to W. T. Henley's Telegraph Works. Train leaves Fenchurch Street 9.40 a.m.

Thursday, May 18th.—At 8 p.m. The Institution of Electrical Engineers, at the Society of Arts, John Street, Adelphi, W.C. Ordinary General Meeting. "Electric Locomotives in Practice, and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design," by P. V. McMahon, member. Discussion.

Thursday, May 25th.—At 12 noon. Institution of Mining Engineers, at the rooms of the Geological Society. Presidential address by Mr. J. A. Longden; papers by Mr. S. F. Walker on "Alternating Currents and their Possible Applications to Mining" (Part I.); Mr. J. E. Dowson on "Metric Weights and Measures;" and other papers.

Friday, May 26th.—At 10.30 a.m. Institution of Mining Engineers. (Second Day.) Among other papers will be one on "A New Process of Seasoning and Preserving Timber and other Fibrous Substances by means of Electricity," by Mr. H. Baillie-Weaver. Among those open for discussion is one on "Experiments on the Ignition of Fire-damp and Coal-dust by Means of Electricity," by Messrs. Heise and Thiem.

THE ALL-BRITISH CABLE.

The pressure of public opinion in the Colonies and in Canada as to the necessity for an all-British cable across the Pacific Ocean has at length produced conviction in the minds of the home authorities that "something must be done." The long delay on the part of Her Majesty's Government in coming to a decision seemed to justify an expectation that when that decision was arrived at it would at least be conclusive. In reply to questions in the House of Commons, we were given to understand that the delay was due to the fact that no joint action was being taken by the Australasian colonies among themselves, and with Canada, and that Her Majesty's Government were only awaiting an announcement of this to deal with the project.

We do not now propose to travel over the history of the various conferences held at intervals during the last 10 or 12 years, at which the subject of the proposed cable has been thoroughly discussed. We only intend here to treat of the report of the Pacific Cable Committee which sat in Downing Street, under the presidency of the Earl of Selborne.* It is on the lines of this report that the Colonies, in agreement with Canada, have proposed to establish the Pacific cable. Much, however, to the astonishment of those who were not behind the scenes, the Imperial Government has disregarded the opinion of the Committee, which was as follows:—"The Committee are of opinion that the cable should be owned and worked by the Governments interested." This report, although only issued to the public about a fortnight ago, is dated January, 1897, and has doubtless been the foundation on which Canada and the Australasian Colonies came to a common understanding, being fully convinced, and

* See Blue-Book C 9,247, April, 1899, Pacific Cable Committee, Report, Minutes of Proceedings, &c.

expecting, that Her Majesty's Government would also adopt the lines laid down in the report on which to join the Colonies and the Dominion in carrying out the work. We find, however, that this is not the case, but that the Imperial Government proposes, after a rather ungracious preamble, to grant a subsidy not to exceed a *maximum* of £20,000 in any one year for 20 years. From this subsidy there is annually to be paid to the account of the "all-British cable" a sum equal to five-eighteenths of the sum by which the net receipts of the cable shall fall short of the amount of the expenses. Now as in the same document it is shown that the deficit is expected to be £12,900 for the first year, diminishing annually until it ceases altogether at the end of the third year, it needs a very short calculation to show that the total of the proposed contribution which the Imperial Government means to make is £6,270! This is certainly not a heavy tax on the British Exchequer. In return for this magnificent contribution the Government claims control as far as the construction of the cable is concerned, and also that all rates should be approved by the Treasury, besides which all Imperial Government telegrams are to be transmitted at half rates and in priority to any other telegrams. The Colonial Office letter dated 28th of last month concludes with the phrase, "Her Majesty's Government trust that the liberal arrangement will meet with the views of the Colonies, and that it will be accepted as a proof of their cordial desire to co-operate with the Colonial Governments in any undertaking of general concern, even although the Colonial interest in the matter may be more direct and apparent than that of this country."

As was to be expected, this production has excited a general sense of indignation throughout Canada and the Colonies, and it may have the effect, which possibly it was intended to produce, of further delaying the completion of this cable; unless the Colonial Governments undertake the work themselves and ask the Imperial Government to withdraw from the partnership. It is not only the smallness of the contribution proposed, and the hampering of the work by placing it under the control of the permanent official class, that constitutes the objection to the Imperial proposition, but it is also that, as has been pointed out in the *Times*, the effect of the Imperial Government declining to become joint-owner of this cable is that, owing to the difference between the prices of Canadian and British stock, the cost of the cable will be increased by £240,000.

It is reported that Mr. Chamberlain is inclined to reconsider the matter, and we sincerely hope so for the credit of this country.

We do not at present propose to deal in detail with the evidence given before the Committee, but hope to do so soon, as it is of a most instructive character, both as to how things should be done, and also how they should not be done.

THE TELEPHONE SERVICE.

THE statement made by Mr. Hanbury to the deputation which waited upon him last week is not encouraging for those who see in telephonic competition something to be avoided. The deputation was from members of Chambers of Commerce and other bodies, and it asked the Government to purchase the National Telephone Company and work it as a department of the Post Office. Mr. Hanbury recognised that a single system, whether in the hands of the National Telephone Company or the Government, or any other body, was the best, but had no difficulty in finding reasons for the establishment of competition, and considered that if, in 1911, the Government found that a national system was better, it was doing nothing at the present moment which would prevent their nationalising the system in that year.

Mr. Hanbury's reference to undue preferences under the present system, and to the question of private wires, seems to be a rather undue straining of minor points, if, indeed, there is evidence of any undue preference at all. It is not easy to understand what was meant by "the exceptionally good terms which the Government had offered the National Telephone Company," but if the terms referred to are contained in the statement made to Parliament by Mr. Hanbury in applying for leave to introduce the Telephone Bill, no surprise need be expressed that the company had failed to take advantage of them. If competition is to be avoided, it will be necessary for both parties to the controversy to see the other side of the case. We do not observe any readiness on Mr. Hanbury's part to recognise that his views are open to criticism, and therefore the pursuance of his preconceived plan may be considered probable. However much consistency may be a subject for admiration, we cannot view without some concern the initiation of a policy which we believe to be detrimental to the interests of telephone users and of the State.

NOTES.

"A Mort! A Mort!!"—Death, graphically represented by the form of a skeleton enshrouded with black draperies, taking flight from heaven to earth, bearing within its bony clutches an electric trolley car! Such, with other equally hideous accompaniments, may be taken to indicate the liking that some Buenos Ayres residents have for electric tramways. The cartoon mentioned appeared in a recent issue of a Buenos Ayres comic paper, and a correspondent, in sending it to us, gives a word or two by way of explanation. Writing on April 9th, he says:—

> This is very much to the point in view of the frequent accidents that have been occurring on the electric tramline since it was opened. Last week they killed three persons—not a bad record for new drivers, but one that will cost them heavily in the lawsuits that are sure to be brought against the company. In this country, as the tram and railway companies know to their cost, the value placed by relatives on those members of their family who are sent to happier climes through their agency is high. Only the other day an action was brought against a company in which the damage was estimated at $120,000. The translation at the foot of the cartoon is, "Death desiring one day that nothing should remain alive in this country, and as there was no other resource to fall back upon, sent us this tramway which is killing so many people."

Our experience with trolley cars in this country has certainly not led us to the opinion that they are "deadly," which term American opponents have long applied to them. We do not anticipate that it will ever be necessary to reproduce this cartoon in the columns of our own English *Punch*. We admit that there may be need for the British pedestrian to be more upon his guard. There are many people who are so absent-minded and careless that they would be knocked down by a donkey barrow, let alone an eight-mile-an-hour trolley car.

The Institution Meeting at Switzerland.—The secretary of the Institution of Electrical Engineers is this week circularising the members with regard to the proposed reunion in Switzerland from September 1st to 10th. The arrangements for this visit are now in progress, and with the kind assistance of Colonel Huber, Mr. C. E. L. Brown, Prof. Wyssling, and others a provisional programme has already been drawn up.

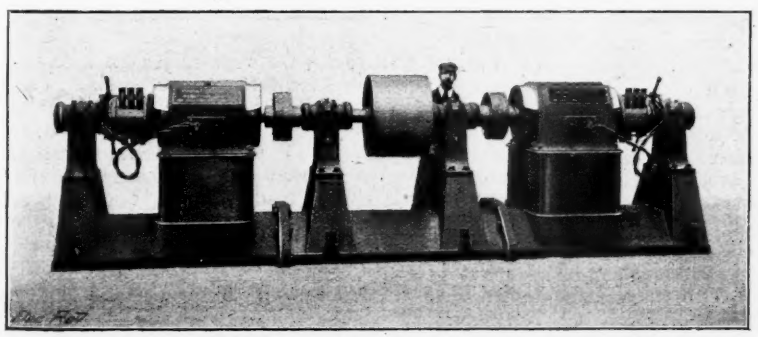
> As at present arranged, members will visit the Rheinfelden Works on Saturday, September 2nd, and will proceed the same day to Zürich, and will remain there until September 6th. During this time visits will be paid to the works of the Oerlikon Company, of Messrs. Brown, Boveri & Co., and of Messrs. Escher, Wyss & Co., and to certain power stations and tramway and lighting installations in the district, including, as it is hoped, a visit to the Schaffhausen Works. They will then proceed to Lucerne, and, after inspecting the street railways of that town, and, if time permit, the Rathhausen Works and the Stanstad-Engelberg Railway, will travel *vid* the Brünig Pass to Interlaken. Here opportunity will be given for visiting both the Jungfrau Railway (*vid* the Wengern Alp route) and the Burgdorf-Thun Railway, as well as other places of electrical interest in the neighbourhood, and the visit will end on Saturday, September 9th. The above programme is, of course, subject to alteration.

Electricity for Autocars.—At the Coventry Engineering Society the other day Mr. J. W. Roebuck (designer at the works of the Beeston Cycle and Motor Companies) opened a discussion on "The Ideal Motor Power for Autocars." He referred to the great possibilities before electricity in this direction, and spoke of its advantages.

Royal Institution.—The annual meeting of the members of the Royal Institution was held last week, the Duke of Northumberland presiding. The annual report of the Committee of Visitors for 1898 showed that 58 new members were elected in 1898; 63 lectures and 19 evening discourses were delivered last year. The President announced that in June next the Royal Institution would complete 100 years of its existence, the first meeting of its members in the building in Albemarle Street having been held on June 5th, 1799. The managers had decided that this event, so interesting and memorable in the life of the Institution, and in the history of science in this country, should be duly celebrated. They had, therefore, arranged for the delivery of two commemoration lectures. The first of these would be delivered at 3 o'clock on Tuesday, June 6th, by Prof. Lord Rayleigh, when the Prince of Wales, Vice-Patron of the Institution, would preside and receive the honorary members; the second of the lectures would be delivered at 9 o'clock on Wednesday evening, June 7th, by Prof. Dewar, when the Duke of Northumberland, President of the Institution, would preside. It was further announced that the Lord Mayor had consented to give a reception to the members, foreign guests, and representative men at the Mansion House on the evening of Tuesday, June 6th.

On 8th inst. the following were elected Vice-Presidents:—Sir Wm. Crookes, Lord Kelvin, Mr. A. B. Kempe, Sir A. Noble, Mr. A. Siemens, Sir H. Thompson, Bart., Sir J. Crichton-Browne, and Sir F. Bramwell, Bart. The President referred in appreciative terms to Mr. Benjamin Vincent, for many years assistant secretary to the Institution, and whose death has recently occurred.

Duplex Dynamo.—The accompanying figure shows a duplex generator which has been installed in the power station of Messrs. Howard & Bullough, machine makers, Accrington. About five years ago this firm made an experiment in electric driving of machinery, and were so pleased with the results that they have made extension after extension, until there are now some 80 motors, averaging 10 H.P. each, at work in their extensive shops. The current required necessitates a fairly large central station, and eight units similar to the illustration have been laid down by Messrs. Thomas Parker, Limited, to deal with the load. Each of the two armatures gives an output of 210 volts, 400 amperes



when running at a speed of 400 revolutions per minute. Either or both armatures may be used at will, and the couplings enable them to be readily taken out without interfering with the belt.

The American Inventor and London Developments.—The American inventor is often a source of considerable amusement to us. His belief in himself, the absolute assurance with which he talks to those who find him the money for his experiments, and the striking modesty of the "inspired" paragraphs relating to his work, which from time to time appear in the American papers, are all in their way inimitable. Of course all these are but manifestations of the genius of the born inventor, for as Mr. Swinburne long ago remarked, "Any fool can invent a thing, but it takes a very clever man to convince others of the value of an invention, and it takes a genius to sell it." The above is *apropos* of a paragraph which recently appeared in *Electricity* (New York) to the effect that Mr. T. Edison (junior) is again on the war-path. But a few months ago this versatile genius was engaged in perfecting electric glow lamps; and since his portrait (enshrined in one of the improved lamps) now adorns a trade advertisement, it would appear that Mr. T. Edison (junior) has, in connection with this invention, risen to the height of Mr. Swinburne's definition. More recently one read in the same paper that Mr. T. Edison (junior) was about to solve the problem of the generation of electricity from tidal energy, and that a large hydraulic installation, based upon his newly invented system, was to be erected near the Brooklyn Suspension Bridge. The youthful genius has evidently settled this small affair in record time, for the latest issue of our New York contemporary, informs us that Mr. T. Edison (junior) has just invented a process for hardening steel, which is expected to revolutionise steel manufacture. Harveyised steel is simply nowhere when compared with T. Edison, junior, steel, and even the new Krupp steel is outclassed. Really T. Edison, sen., will have to look to his laurels. English electrical engineers may, however, be more interested in the facts disclosed by the two extracts given below. These are taken from a recent issue of a New York electrical journal:—

> Prof. Sidney Short, of the Walker Electric Company, of Cleveland, is now in Europe, and, according to the Columbus *Dispatch*, is "representing a big company that will erect a mammoth electrical plant in London which will be in charge of American electrical experts."
>
> Albert Johnson denies the story sent from Detroit that his brother, Tom L., "had given up his intention to retire from business, and would invade London, England, where he was to build a large electric railroad system." Albert Johnson told a Brooklyn reporter that his brother Tom was not interested in a scheme to build a railroad in London. "I am the one," he said. "I am going to make application in a short time from now for permission to build."

It is to be noted that the announcements are somewhat vague and misty, but this atmosphere suits the grandeur of the statements which they convey. Let our electrical engineers be prepared for some striking developments in London.

New Telephone Instrument.—We have received a letter from Mr. M. G. Waggott, of Birmingham, regarding a new telephone system. He has been working and experimenting with a view of making a telephone which would be simple both in transmitting and receiving parts, and also to try to devise an instrument which could be used either as a wall or table telephone, and at considerable less cost than present types. He sends us a photo of an instrument which he believes will meet the above conditions, and which will bear favourable comparison with any instrument which is in use at the present time. As a wall telephone, he claims that it can be adjusted at will to suit the statures of the users, and thus prevent stooping or stretching. The receiver has no permanent magnet. "This no doubt will make it less susceptible to inductive effects from other circuits." The transmitter is constructed in such a way that packing will be almost impossible. It is claimed to be of compact design, and can be made for about half the cost of present day instruments. We have given the matter some amount of consideration, and we find that the advantages referred to in the letter are not shown in any way in the photograph, where there is no indication of any power to adjust to height of user unless by putting a new nail in the wall, which can be done with any other instruments. No description of the interior of instrument is given. The transmitter is of the Berliner form, but has a less graceful outline. The absence of permanent magnets in the receiver is a return to original methods, and is contrary to the accepted theories and practice of the day.

The Machinery Users' Association.—Sir William Houldsworth, Bart., M.P., presides at the annual meeting of this Association to-day (Friday) at 2.30 p.m. at Westminster Palace Hotel.

"Waterfalls for Sale" in the "Spectator."—The following letter and comment appeared in the issue of the *Spectator* for April 15th :—

To the Editor of the *Spectator*.

Sir,—Members of the Bergens Polyteknische Forening would be very thankful for advice from you whom to address, or where to write, in London for sale of waterfalls for industrial use. We can offer powers of 100, 500, 1,000 up to area 8,000 horse-power. Awaiting your good news,

I am, Sir, &c.,

R. FALKENBERG.

Bergen, *April 10th*.

[The above letter is so curious an example of the coming importance of waterfalls as producers of industrial power, that we place it before our readers. We fear, however, that there are as yet no regular waterfall brokers to be found in London.—Editor *Spectator*.]

The oracle of Wellington Street is undoubtedly correct in thinking that the above letter is a sign of the coming industrial importance of water-power. In an article published in the *Spectator* in September, 1897, this was clearly foretold, and the service rendered by electricity in connection with this new source of power, was explained. The editor of the *Spectator* is, however, wrong in his belief that no agencies yet exist by which sales of waterfalls for industrial purposes can be effected. We ourselves know of more than one ; and advertisements of waterfalls for such use are *no* uncommon feature of English, French, and German technical papers. We are afraid the editor of the *Spectator* will find that by publishing the above letter he has laid himself open to an inundation of similar applications. The chance of a free advertisement of saleable waterfalls in the "Correspondence" columns of a paper so widely read, will, we think, prove irresistible to many owners. May we suggest that the editor should forthwith apply himself to the framing of a suitable scale of charges.

Electrical Work in New South Wales.—Mr. A. C. F. Webb delivered his presidential address to the Sydney Electrical Association in March, and in the course of his remarks he briefly outlined the progress of the electrical industry in New South Wales during the last year. He pointed out that 16 electrical supply stations now existed, eight being in Sydney. The total number of 8-candle-power incandescent lamps now connected to the eight metropolitan stations was 25,542, the total capacity of these stations being about 696 horse-power. In addition to the supply stations there were about 70 isolated electric lighting plants equal to 1,500 horse-power scattered throughout the Colony. He drew particular attention to the fact that since the Sydney Municipal Electric Lighting Bill had been passed three new electric supply stations had been erected throughout the city, and plant installed equal to 15,000 8-candle-power incandescent lamps, which might have been connected to the Council's supply, and the cost of compensation avoided. Mr. Webb spent some time in discussing the advantages of electric motors for workshops and factories, pointing out the great economy obtained through shafting and belts not being required. He deplored the continued delay in putting the General Electric Lighting Act before Parliament. Reference was made to the increased use of electric traction, and the determination of the Railway Commissioners to convert the whole of the steam tramways to electric traction. During last year five miles of single line were equipped for electric traction, making a total of 9 miles 3 chains now open for traffic. The total number of electric cars have increased from five to 17. The electric car mileage for the month of February, 1898, was 10,634, while the car mileage for the corresponding month, 1899, was 24,431. Additional generating power of 400-kilowatt capacity and large storage batteries had been installed both on the North Shore and Rose Bay lines. Mr. Webb proceeded to discuss in detail the best method of wiring and fitting up freezing and chilling chambers, breweries, meat preserving works, &c., and advocated a special construction of water-tight fittings.

The Institution Conversazione.—Mr. W. G. McMillan informs us that the annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on the evening of Thursday, June 15th.

What Happened to the Deputation.—No respectable municipality can attain to the acme of respectability unless it has its deputations. It may be that in electric lighting the municipal mind would now receive no enlightenment from a few days' tour. That does not matter, we must have a deputation, and though in the town next door there is a very complete electric tram system, a deputation must go to the Continent. They have been sent by other towns, why not send half a dozen of our leading lights to see what they've got a thousand miles away? Such might almost be the argument, for it is remarkable how ready Councils are to imitate in this direction towns, to which in other ways they hold themselves to be vastly superior. When electric tramway deputations have performed their labour of love, we are not at a loss for another subject for them to investigate. We will let them go to such and such a town "and elsewhere" (delightfully vague, giving such a wide margin !) to see what they can find out about mechanical stokers. And when the party comes marching home again, though one may be a grocer and another a butterman, these gentlemen are so profoundly learned that the borough engineer must lift his hat in awe, and think it time he sought fresh fields and pastures new, where his little knowledge might, perhaps, be of at least some account. The doings of these deputations are matter of more or less mystery, and we believe that sometimes the members have even lost one another when on tour. Their diaries are not open to the public inspection, so we are not quite in a position to say of which new traction system, electric generator, or mechanical stoker they were seeking knowledge. Perhaps it is not yet patented. Belfast is sending a deputation to find out something about mechanical stokers, and when the matter came before the Corporation the other day, Councillor Young divulged some interesting history regarding a former deputation :—

He remarked that some time ago the Corporation sent a deputation to look after electric traction. "They went to Glasgow and Bristol, and to London and Paris and Brussels, and then to Buda-Pesth, where I think they got lost. In each place a State entry was made. The municipal authorities were informed beforehand that the Right Hon. the Lord Mayor and Sir Samuel Black and a number of members of the Belfast Corporation would wait on them at such a date, and the result was that the town was illuminated, and they got to such a pitch before they reached Buda-Pesth—the foreigners charged so highly—that they dropped the title of Lord Mayor, and Sir Samuel Black became plain Samuel Black, and they thus obtained cheaper terms. I have never seen the account of that excursion put before the Corporation to be passed."

Alderman M'Cormick: Were they paid?

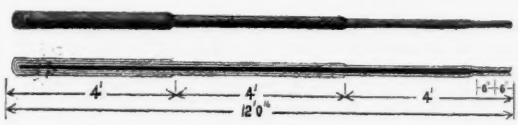
Alderman Dempsey: The expenses went into the wages book.

The Fulham Contract.—On Wednesday night the question of the electric tenders for the lighting of Fulham again came before the Vestry. Previous to the Vestry meeting the question was threshed out at great length in committee, before which Mr. Hirst, of the General Electric Company, attended. At the Vestry meeting the amendment to give the mains to the British Insulated Wire Company was defeated. It was afterwards agreed to add a clause to the contract fixing a £10 penalty for breach of the trade union wages and conditions. Another amendment to further postpone the matter was defeated, and ultimately the tender of the General Electric Company was accepted.

The Liverpool Car Contract.—When the proposed car contract came before the Town Council's meeting last week, the chairman of the Tramways Committee dissented from No. 5 of his committee's recommendations, which was that the contract being given to Messrs. Dick, Kerr & Co. In his dissension, Mr. Rutherford stood alone. He was decidedly of opinion that the Westinghouse Electric Company, or some "such famous firm," should have the major part of the contract. Mr. Wood "hinted that a representative of an opposing firm had seen the chairman after the tender was accepted by the sub-committee, and he believed that it was as the result of that interview that the chairman arrived at his decision." He said that he, the chairman, had received certain information from the Westinghouse Company's representative. From these brief comments an idea of the character of the discussion may be gained, but we must refer our readers to the *Liverpool Post* for May 4th for a report of the speeches. The upshot of the affair was the confirmation of the committee's recommendation to give the contract to Messrs. Dick, Kerr & Co. for the whole 80 cars.

Cape Town Tramways and Submarine Cables.—An action in which the Eastern Telegraph Company claim £50,000 damages from the Cape Town Tramway Company, has been commenced and will shortly come for trial before the Supreme Court of Cape Colony. The damage is alleged to have been caused by interference with the Telegraph Company's cable system by leakage from the wires of the electric tramways. We are informed that partly in consequence of this claim the Durban Corporation have given notice to the company to remove the pipe containing the cable from the streets of the town. The pipe has been used for years without payment of rent, but was laid during the pleasure of the Town Council, who are now contemplating the installation of an electric tramway system.

Cold Drawn Seamless Trolley Pole.—The annexed illustration from the *Street Railway Journal* represents a pole made by the Shelly Steel Tube Company, of Cleveland, Ohio. It is built up of three pieces of cold-drawn high carbon seamless steel tube, put together as shown and cold welded. It is claimed to give by this method a pole of minimum weight and maximum strength which will meet all requirements of traffic.



Appointments Vacant.—The Leeds City Tramways Committee is wanting a traffic manager to take complete control of traffic arrangements in connection with about 50 miles of single track, comprising about 180 cars (electric, steam and horse). Applications have to be lodged with the chairman by 15th inst. Particulars from the town clerk.

The Newington Vestry wants two charge engineers for the electricity works. The Hampstead Vestry is advertising for an assistant electrical engineer. The Leeds Corporation want an engineer in charge for the electricity works. See our "Official Notices" this week for particulars.

The Hereford Electric Lighting Committee want a clerk of works for the electricity works. See "Official Notices" this week.

Mason's College.—There have lately been additions and alterations made to the equipment of the mechanical and electrical engineering department of the Mason University College, Birmingham. The additions to the electrical department include two continuous current 5-kilowatt dynamos (Messrs. Chamberlain & Hookham), two 5-kilowatt alternators, arranged for single, double and three-phase currents (Messrs. Thomas Parker), experimental transformer (Messrs. Johnson & Phillips), battery room and switchboard, measuring instruments, Western voltmeters and ammeters, Weston wattmeter and photometric gallery. A galvanometer room has been fitted with galvanometers, standard resistances, potentiometers, Clark cells, &c. The cost of the new apparatus has been met by donations.

Cocksureness.—In last week's issue of a contemporary we find what is called a condensed digest upon the "disappointing report" of the Pacific Cable Committee. It is apparent that the writer had not read the evidence attached to the report, or on one point at least he would have gained information, that is, as regards the amount of slack required in laying a cable in about 3,000 fathoms and under, the writer in question says boldly that 10 per cent. of slack is not enough. Now, on turning to the evidence in the report, we find that according to the representatives of various cable-laying companies this amount is considered sufficient by the Telegraph Construction and Maintenance Company, the Silvertown Company, Messrs. Clark, Forde & Taylor, and others, 7 or 8 per cent. being regarded as sufficient by Messrs. Henley. With such information, and the knowledge that several of the latest laid cables in waters of a depth of 3,000 fathoms and over, have a percentage of slack less than 10, it is to be hoped that the author of the note in question will write in a less dogmatic manner in future.

Electric Eddy Currents.—On Tuesday afternoon Prof. S. P. Thompson delivered his second Tyndall lecture on this subject at the Royal Institution.

NEW COMPANIES REGISTERED.

North Metropolitan Electrical Power Distribution Company, Limited (61,592).—This company was registered on April 19th, with a capital of £50,000 in £10 shares (2,500 preference), to carry on the business of electrical engineers and contractors, electricians, suppliers of electricity, electrical apparatus manufacturers, mechanical and chemical engineers, tramway and light railway proprietors, carriers, &c. The first subscribers (each with one share) are:—G. J. Somerville, 35, Shepherd's Bush Road, W., electrical engineer; C. Walmsley, 17, Priory Road, Kew, W., accountant; E. Garcke, Donington House, Norfolk Street, W.C., director; C. H. Dade, 36, Albacore Crescent, Lewisham, S.E., assistant secretary; W. E. Singleton, 2, Elm Villas, Elm Row, Hampstead, solicitor; M. E. Sheerboom, 6, Ferncliff Road, N.E., clerk; J. Renwick, 29, Hillside Road, Stamford Hill, N. clerk. The first directors (to number not less than three nor more than five) are to be nominated by the subscribers; qualification £100; remuneration as fixed by the company. Registered office, Surrey House, Victoria Embankment, W.C.

County of Surrey Electrical Power Distribution Company, Limited (61,593).—This company was registered on April 19th, with a capital of £50,000 in £10 shares (2,500 preference), to carry on the business of electrical engineers and contractors, electricians, electrical apparatus manufacturers, suppliers of electricity, tramway and light railway proprietors, carriers, &c. The first subscribers (each with one share) are:—G. J. Somerville, 35, Shepherd's Bush Road, W., electrical engineer; C. Walmsley, 17, Priory Road, Kew, W., accountant; E. Garcke, Donington House, Norfolk Street, W.C., director; C. H. Dade, 36, Albacore Crescent, Lewisham, S.E., assistant secretary; W. E. Singleton, 2, Elm Villas, Elm Row, Hampstead, solicitor; M. E. Sheerboom, 6, Ferncliff Road, N.E., clerk; J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk. The first directors (to number not less than three nor more than five) are to be nominated by the subscribers; qualification, £100; remuneration, as the company may determine. Registered office, Surrey House, Victoria Embankment, W.C.

Morecambe Electric Launch and Power Syndicate, Limited (61,861).—This company was registered on May 2nd, with a capital of £3,000 in £1 shares, to adopt an agreement with Joseph J. Hargreaves, Joseph Hayes, and Wm. H. Pickles, and to carry on the business of motor manufacturers, launch, ship, and boat builders, electricians, suppliers of electricity, engineers, machinists, fitters, founders, wire drawers, tube makers, &c. The first subscribers (each with one share) are:—Joseph J. Hargreaves, 5, Hornby Terrace, Morecambe, traveller; Joseph Hayes, 16, St. Margaret's Terrace, Great Horton, Bradford, electrical engineer; William H. Pickles, Cross Copp, Heysham, gentleman; Thomas L. Wilson, 3, Victoria Buildings, Morecambe, ironmonger; Charles D. Collinson, Fairfield Road, Hynsham, architect; Henry Waters, 2a, Euston Road, Morecambe, accountant; Ratcliffe Nuttall, 11, Finsbury Park Road, N., surgeon. The first directors (to number not less than three nore more than seven) are to be nominated by the subscribers. Remuneration as the company may decide.

Snetzler's, Limited (61,865).—This company was registered on May 2nd, with a capital of £2,000 in £5 shares, to adopt an agreement with Walter R. Snetzler, James R. Baillie, and Charles B. Halliley, and to acquire and carry on the business of a mechanical and electrical engineer carried on by Walter R. Snetzler at Little James Street, Gray's Inn Road, W.C. The first subscribers (each with one share) are:—Walter R. Snetzler, 79, Gaskarth Road, Balham Hill, S.W., engineer; James R. Baillie, 1, Akenside Road, N.W., gentleman; Samuel G. Moore, 20, Clarendon Road, Edgbaston, Birmingham, gentleman; Charles B. Halliley, 26, Mill Street, Bedford, solicitor; Harry Bell, 30, Mill Street, Bedford, auctioneer; Alfred J. Reade, 18 and 20, Mill Street, Bedford, merchant; Fred. S. Dodson, Pembroke Street, Bedford, accountant. Registered without articles of association.

Belliss & Morcom, Limited (61,890).—This company was registered on May 3rd, with a capital of £300,000 in £10 shares (15,000 preference), to acquire the business now carried on by G. E. Belliss & Co., Limited, at Birmingham and elsewhere, to enter into an agreement with the said company, and to carry on the business of mechanical, hydraulic, marine, electrical and general engineers, boiler makers, engine makers, metal founders, rollers, piercers, stampers and workers, carriage and motor car builders, &c. The first subscribers (each with one share) are:—George E. Belliss, The Dell, King's Norton, Worcester, engineer; Alfred Morcom, 24, Augustus Road, Edgbaston, engineer; Albert C. Pain, Beverley, Lyttleton Road, Edgbaston, engineer; Francis O. Everard, The Croft, Albert Road, Harborne, Birmingham, engineer; Geo. B. Parrott, Fairlight, Westfield Road, Edgbaston, secretary; Thomas H. Parrott, Fairlight, Westfield Road, Edgbaston, manager; and John Belliss, 64, Francis Road, Edgbaston, engineer. The number of directors is not to be less than two nor more than seven; the first are George Belliss, Alfred Morcom, and Albert E. Seaton; qualification, 100 ordinary shares; remuneration, £200 each per annum, and £300 for the chairman.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle-upon-Tyne Electric Supply Company, Limited (27,997).—This company's annual return was filed on March 13th, when 12,370 shares were taken up out of a capital of £100,000 in £5 shares; 412 are considered as paid, £5 per share has been called on 8,958, and £2 10s. per share on 3,000, resulting in the receipt of £52,526.

National Telephone Company, Limited (15,066).—This company's annual return was filed on March 30th, when the whole capital of £4,000,000 in 15,000 first preference shares of £10 each, 15,000 second preference shares of £10 each, 250,000 third preference shares of £5 each, and 490,000 ordinary shares of £5 each was taken up; 28,284 third preference and 44,413 ordinary shares are considered as paid, and the full amount has been called on the others. £3,636,515 has been paid.

Northwich Electric Supply Company, Limited (46,958).—This company's annual return was filed on March 21st, when 3,000 shares were taken up out of a capital of £25,000 in £5 shares. £5 per share has been called, and £12,390 paid, leaving £2,610 in arrears.

Telegraph Construction and Maintenance Company, Limited (1,147 C).—This company's annual return was filed on March 22nd, when the whole capital of £448,200 in £12 shares was taken up and paid for in full.

Anglo-American Telegraph Company, Limited (2,891).—This company's annual return was filed on March 28th, when the whole capital of £7,000,000 in stock was fully taken up and paid for.

Notting Hill Electric Lighting Company, Limited (25,921).—This company's annual return was filed on March 25th, when the whole nominal capital of £100,000 in £10 shares (6,452 ordinary, 550 founders', and 2,998 preference) was taken up and paid for in full.

City of London Electric Lighting Company, Limited (34,406).—This company's annual return was filed on March 23rd, when 60,000 ordinary and 40,000 preference shares were taken up out of a capital of £1,200,000 in £10 shares, and paid for in full.

British Columbia Telephones, Limited (59,084).—This company's statutory return was filed on February 10th. The capital is £100,000 in £10 shares (3,000 preference). 2,000 preference and 3,000 ordinary have been taken up. £10 per share has been called on the preference and £7 10s. on the ordinary, and £42,500 has been paid.

CITY NOTES.

W. T. Glover & Co.'s Debenture Issue.

This company is issuing at par £60,000 4½ per cent. first mortgage debenture stock, which is part of a total authorised issue of £100,000 debenture stock. The stock is to be paid off at par on July 1st, 1919, but power is reserved to the company to pay off all or any of the stock at 105 on or at any time after July 1st on six months' notice, any partial redemption being by drawings. The proceeds of the present issue will be mainly devoted to considerable extension of the works, which has been rendered imperative by the increasing business. The audited balance-sheet for the year ending December 31st, 1898, shows profits of £17,103, which permitted the payment of a 5 per cent. dividend on the preference shares, and a dividend of 8 per cent. per annum on the ordinary shares. The growing nature of Messrs. Glover's business, as well as the firm's reputation, are sufficient to make the present issue a desirable investment.

Brazilian Submarine Telegraph Company.

The fifty-first ordinary general meeting of this company was held at Winchester House on Wednesday under the chairmanship of Mr. W. S. Andrews, who, in moving the adoption of the report, said he had uncommonly little to say, the fact being that the even course of prosperity of the Brazilian Submarine Telegraph Company continued, but was particularly uneventful. It was very agreeable, of course, and it would be much better to find themselves upon the highway to a prosperous career rather than to meet with all sorts of obstacles, which, while making good material for a chairman's discourse, might be peculiarly unpleasant for the shareholders. The arrangement which was carried out for the benefit of the shareholders in bringing the lines together had, so far worked exceedingly well, and they had met with no difficulties. Everything had been advantageous, as far as they could trace the present effects, and there was no reason to regret what they had done, but rather, there was every reason to congratulate themselves upon the measure which they had carried out. That arrangement was not merely to the benefit of the shareholders, which was one of the principal objects they had in view in carrying it out, but it would prove to be exceedingly satisfactory to the Governments and to the mercantile community interested in their communication with the Western Hemisphere. The income for the half-year ending December 31st amounted to £115,159, as against £103,689 in the previous half-year, an increase of £11,470. This was mainly due to an increase of £12,426 in message receipts. There was a falling off of £1,220 received from dividends paid on shares in other telegraph companies, but that was simply a question of the shifting of dates, and the dividends did not happen to come into that particular half-year. On the expenditure side they found the total expenditure for the half-year £22,253, against £21,474, an increase of £779. They had again, he was pleased to say, been free from accidents or repairs to cables; but, of course, while they could congratulate themselves that year, they must remember that was always an unknown quantity. They got the benefit when there were no repairs; but, of course, they must bear it when there were repairs. There was a special item of expenses which would not be recurrent in connection with certain necessary steps taken to protect the interests of the cable companies from taxation in the River Plate territory. The amount was £1,693. It was deemed undesirable to increase the capital expenditure by items which were not represented by actual property, and the directors had, therefore, placed against profits the expenses of carrying out the arrangements of a closer working union with the Western Brazilian and the Platino-Brazilian Companies, the effect of which he had referred to. They had already previously alluded to the Lisbon-Madeira No. 1 cable being in a faulty condition, but it continued to do its work, and, therefore, no attempt had been made to repair it because they did not like to disturb those long cables laid in deep waters as long as they did their work. But they would understand that there was no certainty as to its continuance in good working order, and it was a thing they would have to tackle by-and-bye. The same thing would apply to the Lisbon-St. Vincent No. 2 cable. That had fallen in electrical value, and it would have to be put into proper electrical condition. The fact was their cables were not getting younger, and he might say the same of those who were managing them, but, unfortunately, those who managed the cables could not renew themselves as they could renew the cables. He knew there had been discussions at these meetings with regard to reserves, but they must not forget that they were increasing their responsibilities, and although he did not say that the other companies could not defray their share of the shot, at the same time temporary aid might be required, and they, therefore, wanted all the money they could command to ensure the good maintenance of the largely extended system they now represented. The position of the company with the Governments and with the public all depended on the thorough efficiency of their plant.

Mr. J. D. Pender seconded the motion, and the report was adopted.

Western and Brazilian Telegraph Company, Limited.

Mr. W. S. Andrews, chairman, presided on Wednesday over the thirty-seventh ordinary general meeting of the above company, held at Winchester House.

In moving the adoption of the report, he said the accounts for the half-year ended December 31st showed a revenue of £79,103 18s. 7d., as against £72,332 9s. 10d. for the corresponding half-year of 1897, thus showing an increase of £6,771 8s. 9d. in the receipts, which was a satisfactory outcome as regarded the traffic. The expenses amounted to £43,179 1s., as compared with £37,774 1s. 11d., showing an augmentation of £5,404 19s. 1d. That was not quite so satisfactory, because it was in a direction they did not usually like to see. As regards the increased receipts he did not propose to say anything. As regarded the expenditure under Abstract A, salaries and wages were £382 19s. 10d. more and rent and taxes £189 more; furniture for the new offices at Rio was £363 5s. 1d., and expenses of removal and various items in maintenance account £2,070 1s. 7d. He might tell them that they did not change their offices at Rio without very careful investigation of the whole circumstances of the case, that they had succeeded in exchanging offices which were not very suitable for their requirements for an office which was a better centre for the trade of the place, and they believed it would have a very happy effect upon their receipts. In Abstract B coals showed an increase of £799 12. 5d., mainly owing to the effects of the strike, so they could see how reaching the effects of the strike were, and how disastrous it was upon trade and commerce, because they not only spent a great deal more on coals, but the coal they did obtain flared away and did not produce the same horse-power that would have been produced by the same consumption of Cardiff steam coal. He had no doubt but that British interests were handicapped very generally by the same circumstance. There was an item of cable repairs, £1,976 5s. 1d., charged to revenue and other expenses in connection with the bringing about of a closer working between the companies which they all warmly approved of, judging by their action subsequent to the resolutions which were come to. Those expenses came to £956 15s. The London expenses, owing to the re-arrangement, had decreased by £957, which was always a popular reduction with shareholders. The outcome of the working was, including the amount brought forward from June 30th, 1898, and the dividend receivable upon the shares held in the "Platino" Company, and after providing for income-tax, the balance to the credit of the revenue account was £39,204 8s., from which had been deducted £8,037 12s. 4d. for interest on debentures and debenture stock, £1,079 10s. had been placed to debenture stock redemption fund, and £9,000 to reserve fund, leaving a balance of £21,087 5s. 8d. The directors now recommended the payment of 4s. per share, free of income-tax, for the half-year on the ordinary shares, making, with the dividend paid in November last, 3 per cent. for the year, leaving a balance of £1,607 13s. 8d. to be carried forward. The iron barque *Norma* has been purchased, and sent out to Brazil to be used as a hulk for ships' stores and stock cable. That,

of course, increased the expenses for the half-year, but it really went to ensure future economy and greater facilities for handling picked up cable in repairing. That, therefore, would ultimately prove a considerable economy. The tenth annual drawing of the "A" and "B" debentures took place at the company's offices, on January 25th last, in the presence of Mr. H. de Meray, notary public, when debentures amounting to £19,000 were drawn; of these £8,500 "A" and £9,800 "B" had already been exchanged for debenture stock, and the balance, viz., £700 "B" debentures, had since been paid off at par. Of course they knew that most of the old debentures had been exchanged, although they were obliged, in order to maintain the rights of the few of the shareholders who did *bonâ fide* continue to hold that kind of security, to deal with them just the same as if they were all in existence.

Mr. D. H. Goodsall seconded the motion, and it was carried.

New General Traction Company, Limited.

The report of the directors presented at the third annual general meeting of the shareholders, held at the Cannon Street Hotel on Monday last, stated that the gross profits for the year were £17,517 2s. 7d., to which has to be added £4,312 15s. brought forward from last year, making a total of £21,829 17s. 7d. Deducting from this £4,495 12s. 9d., the amount of general expenses, salaries, &c., chargeable against revenue, there remains the sum of £17,334 4s. 10d. as the net profit to be dealt with. From this the directors propose to write off £2,122, the remaining half of the cost of the issue of the new capital, which leaves a balance of £15,212 4s. 10d. A dividend at the rate of 6 per cent. on the preference capital for the past year amounts to £9,000, and the directors recommend that this be paid, and the balance of £6,212 4s. 10d. carried forward to next year. The work on the lines of tramways being constructed under this company's direction has made good and satisfactory progress during the year. The new Coventry lines are near completion, and will, it is confidently anticipated, be opened in the course of the next two months; meantime the section already open for traffic shows continually increasing earnings. The work at Norwich is proceeding satisfactorily. An issue of £100,000 of preference capital was successfully made in 1897; and in view of the already considerable expenditure of capital on the works in progress, and of further business lately undertaken, the directors propose to ask the sanction of the shareholders to a further issue of a like amount of preference capital. For this purpose meetings of the shareholders are called to approve of the creation of 20,000 new preference shares of £5 each, bearing 6 per cent. dividend and ranking *pari passu* with the existing preference shares. A considerable amount of new business has during the past year been offered to the company, but, after careful examination, only one proposal was accepted, the board being anxious to confine operations to what appears to be not only profitable but also intrinsically sound business.

Mr. Francis Pavy presided at the meeting, and, in moving the adoption of the report, stated that the gross profits in the past year had been £17,517, which was increased by the amount brought forward to £21,829. The net profit was £17,334, from which the board had taken £2,122, the balance of the expenses of the issue of the preference shares made some time ago. Out of the balance which was then left of £15,212, they recommended the dividend of 6 per cent. on the preference capital, leaving £6,212 to be carried forward, as compared with £4,495 brought forward. He thought the directors were justified in saying, from these figures, that the position of the company was very satisfactory. The company held interests in the Douglas Tramway (Isle of Man) and in the Coventry lines. Of the latter 6 miles had been opened, and had earned a good dividend on the money expended on their construction; in fact, the working of this portion of these tramways showed a dividend of about 3 per cent. on the whole capital which the company had put into this concern. The new portion of the Coventry undertaking would, he believed, be opened in four or five weeks, and it would, he anticipated, give as good, if not better, results. The undertaking at Norwich was much larger than that at Coventry, and he hoped that it would be opened before the year was out. He anticipated very good results, indeed, from the company's work in Norwich. The directors could not go on with the works in hand without capital to meet all requirements. He ought to add that they had taken another contract for work in the outskirts of Philadelphia.

Baron Emile B. d'Erlanger seconded the motion, which was adopted; and resolutions were also passed sanctioning the creation and issue of 20,000 new preference shares of £5 each, bearing 6 per cent. interest.

The Great Northern Telegraph Company, Limited.

The following is an abridged report of the general meeting held at Copenhagen on April 29th, 1899, which has been forwarded to us by the company:—

The chairman and managing director, Commodore E. Suenson, D.R.N., in rendering an account of the working of the company during the year 1898, made the following remarks:—The condition of the cables during the year 1898 has been much the same as during 1897. In Europe there have been 30 interruptions, affecting nine of the cables, while in the Far East there have been 11 interruptions of six of the cables. The cable steamer, *H. C. Orsted*, has been employed on active service for 201 days, of which 20 were for the account of others, W. T. Henley's Telegraph Works Company having chartered the ship for the transport from London, and the laying in the Baltic, of a cable between Sweden and the island of Gothland for the Swedish Government. The work was successfully carried out during the last fortnight in May. Our cable steamer, *Store Nordiske*, has been on active service for 113 days, of which 37 were for the account of others, and the extraordinary repairs of this steamer and the renewal of boilers, mentioned in last year's report, were finished at Shanghai towards the end of January. Although there is still room for improvement with regard to the Wladiwostock Line, it has worked more regularly than during the previous year. The scheme for laying a cable between Great Britain, the Faroe Islands, and Iceland has made some progress, the Danish Government having rendered valuable assistance by allowing two men-of-war to make surveys and soundings off the coasts of the Faroe Islands and Iceland during last year, in order to find the best landing places for the cable. Meanwhile the company has sent out an experienced engineer to survey the eastern, northern and western parts of Ireland, with a view of selecting a convenient route for the establishment of a landline to connect the most populous districts of that great island with the landing-place of the cable. Unfortunately, however, our efforts to obtain efficient support of the scheme from Great Britain and France have hitherto led to no practical result, notwithstanding its unquestionable importance both from practical and from scientific and humanitarian points of view. The last hope for a speedy realisation of the plan depends now upon steps taken by the Danish Meteorological Office to induce the Meteorological offices abroad to influence their respective Governments in favour of the scheme. The rates between Great Britain and the Scandinavian countries have been reduced since July 1st last but, thanks to an exceptional development of the shipping and commerce of the Scandinavian countries, these reductions have not affected our traffic receipts as much as was expected. In Japan we have had to pull down and completely rebuild our station at Nagasaki, as it was in a very bad condition. During the rebuilding the Japanese Administration has most hospitably given us shelter in their building, which adjoins ours. In China the commercial and industrial development, together with the political events, have contributed to maintain a brisk telegraphic traffic. In addition to this, the insurrection in the Philippines, and later on, the war betwen the United States and Spain—the scene of which was partly laid in those islands—gave rise to a considerable telegraphic correspondence, which explains the highly satisfactory increase of our traffic receipts. In fact the returns show an increase of £21,833 7s. 1d. over those of the year 1895, which had been the best year hitherto. As the additions to the amortisation fund in the previous years brought that fund up to the full amount of our debt, we have taken advantage of the reservation made at the time of the issue of our 5 per cent. debentures of 1883 to pay off extraordinarily 800 of them on September 1st last, thus reducing the remaining number to 700 (£70,000) which likewise have been paid off on March 1st, 1899. In consequence of the excellent results of the year, we are glad to be able to propose an extra dividend of 7½ per cent. (making 12½ per cent. for the year in all), and at the same time to increase the reserve and renewal fund by a substantial amount, the said fund having been debited with a large amount for extraordinary expenses. The increase of this fund is the best guarantee for the shareholders against future contingencies, especially in connection with the British and American schemes for the laying of cables in the Pacific Ocean. The company has to regret some painful losses, through the death of Mr. Bille, who had been an able member of the board of directors since 1885, and through the death of Mr. Berner, who for 25 years had performed his duties as one of the auditors of the company in the most conscientious manner. In the current year we have suffered another sad loss by the death of our engineer-in-chief, Mr. P. Chr. Dresing, one of the ablest of the company's officers.

Brockie-Pell Arc Lamp Company.

Lord Suffield (chairman) presided over the third ordinary general meeting of the above company held at Winchester House, Old Broad Street, E.C., on Monday.

In moving the adoption of the report, his Lordship said he knew before he came there that he could not expect to see those smiling faces which they might hope to see, before long, at these meetings. Many circumstances had prevented them being able to present such a satisfactory account of their proceedings as they might naturally wish for, but he was bound to say, from the directors' point of view, their business had been extremely satisfactory. They had had no end of difficulties, but he need not recapitulate them, as many of them knew what they were. They had contended with those difficulties, and they had practically triumphed over them. He would not make a formal speech, for he treated them as all friends of the undertaking, for they all went into it with the hope of making it a large success. He thought in a short time—probably next year—they would be able to show a much better state of things. He was bound to say that state of things was greatly due to Mr. Shrimpton, who was appointed managing director at a rather critical time by a committee of the largest shareholders. The late managing director considered himself too old to manage the affairs of the company, or, at any rate, if he was not too old, his other engagements prevented him from giving the attention he felt in his heart was necessary to carry out the affairs of the company. He could tell them honestly that the board had not neglected the business. They had worked very hard, and since he had entered into business matters, which was only some few years, nothing had given him greater trouble than that. But they saw the light now. The great difficulty was that they had had with the people who had the license. Messrs. Johnson & Phillips had given them infinite trouble, and behaved in a way hardly to be expected by people in the position they held. These people pirated the invention of Mr. Brockie, which that company bought, and sold them as their own. That at last was brought to a climax, and but for some mistaken feeling, legal proceed-

ings should have been taken two years ago. In the future, if they found that firm selling their lamps they would have to go to prison. He might refer to the orders which had been acquired by the company. In 1897 they had 535 orders; in 1898, 831 orders, and in the four months of that year, 358 orders. In 1897 they sold £9,609 worth of lamps, and in 1898, £17,255 worth. That bore out what he had said that the company now was a very prosperous one. If the present board of management was left alone they would make it a great success.

Sir Fredk. Dixon Hartland seconded the motion.

Mr. A. Waugh moved as an amendment that the report be not adopted, and that the present board of directors be asked to resign. He said that notwithstanding the congratulatory nature of the report they had added £1,496 to the loss, bringing it to £6,286. The question was, How was it they had that continued loss with a continuous and growing demand for the lamp? Then they received £500 for foreign patents and £675 for infringement of patent, which they would not get in the balance-sheet, and if that was added to the loss it would make a loss of £2,600 on the year. Mr. Shrimpton had been appointed by a committee of three, and he was one of the gentlemen who were interested in the vending of the company. Mr. Shrimpton had no knowledge whatever of electric lamps or of electrical business, and he entered his protest against a gentleman having no technical knowledge being appointed to manage the company.

Mr. Bowner seconded the amendment, and after some further discussion,

Mr. Brockie said he had no feeling against the directors except that they had eliminated the technical knowledge of the business. He knew Mr. Shrimpton was a most energetic man, but he had usurped every post of authority in the works, then he thought the directors took too much money. Being practically debarred from fulfilling his obligations to the company, he had spent £1,500 out of his own pocket in perfecting his automatic lathe, which he hoped would be a success.

Sir Fredk. Dixon Hartland made a long reply, and said that although Mr. Brockie was a clever engineer, he understood nothing about commercial matters, and one of the greatest difficulties of the company was the friction which existed between the managing director and Mr. Brockie. It would be better that Mr. Brockie should put his shoulder to the wheel, and work for the future loyally. If they preferred to leave the management of the company to Mr. Brockie, he was quite willing to stand aside.

Mr. Shrimpton said he found everything in absolute chaos when he came on the board, and he found out where the money was lost, and put a stop to it. Mr. Shrimpton proceeded to go into the details of the business with a view to showing that Mr. Brockie had failed to supply proper working drawings of the lamps invented.

After further discussion, the motion for the adoption of the report was defeated on a show of hands.

The Chairman said they would take the poll now, but this was strongly protested against.

Sir F. Dixon Hartland said the question before them was whether the directors or Mr. Brockie was to manage the business.

The Chairman said the meeting would be adjourned, but the whole board would not be present.

Sir Fredk. Dixon Hartland said he would move that the board retire.

This was not seconded.

After the meeting had lasted 2½ hours a poll was taken on the adoption of the report, and the result was 27,000 votes for the board and 21,000 against.

The report was thus carried.

West Coast of America Telegraph Company.

The ordinary general meeting of this company was held at Winchester House on Tuesday, under the presidency of Mr. J. Denison Pender.

The Chairman said that during the past year there had been little or no improvement in trade on the West Coast of America generally, and as a result of a financial crisis in Chili last July there was a fall of about 33 per cent. in the rate of the Valparaiso exchange in London. When the exchange kept moving up and down it rendered business speculative, and consequently difficult to carry on. A better feeling had, he was glad to say, taken place between the Argentine Republic and Chili, and if the relations between those two States would settle down permanently, and there was an end of the talk of diplomatic differences, they would certainly get better trade. He could not hold out the hope of bright prospects, but if there was a better feeling, and a steadier and improved exchange, they would benefit by it.

Sir A. Cattell seconded the motion for the adoption of the report, which was carried unanimously.

West India and Panama Telegraph Company, Limited.—The directors recommend a dividend for the six months ended December 31st, of 2s. 6d. per share on the ordinary shares, tax free, carrying forward £4,920.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending May 6th, 1899, were £419 6s. 5d.; aggregate to date £4,860 7s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending May 5th, 1899, were £2,815 5s. 1d.; corresponding period, 1898, £2,478 2s. 4d.; increase, £337 2s. 9d.

The City and South London Railway Company.—The receipts for the week ending May 7th, 1899, were £995; week ending May 8th, 1898, £964; increase, £31; total receipts for half-year, 1899, £20,353; corresponding period, 1898, £19,721; increase, £632. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending May 6th, 1899, were £151 11s. 5d.; week ending May 7th, 1898, £130 11s. 8d.; increase, £20 19s. 9d. Total receipts to date, 1899, £2,731 9s. 5d.; corresponding period, 1898, £2,082 2s. 8d.; increase, £649 6s. 9d. Miles of track open week ending May 6th, 1899, 3; week ending May 7th, 1898, 3. Car miles run week ending May 6th, 1899, 4,127; week ending May 7th, 1898, 3,100. Number of cars, week ending May 6th, 1899, 11; week ending May 7th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, May 5th, 1899, were as follows:—D. U. T. Co., horse cars, £1,810 14s. 2d.; ditto, electric cars, £1,086 3s. 11d.; D. S. D. Co., electric cars, £772 19s. 2d.; total, £3,669 17s. 3d.; corresponding week last year—D. U. T. Co., horse cars, £2,634 9s. 8d.; ditto, electric cars, £816 15s. 1d.; D. S. D. Co., electric cars, £448 12s. 3d.; total, £3,899 17s.; increase, £270 0s. 3d.; aggregate to date, £60,177 16s. 9d.; ditto last year, £57,069 8s. 2d.; increase to date, £3,108 8s. 7d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending May 7th, 1899, amounted to £1,426; corresponding week last year £1,504; decrease, £78.

The South Staffordshire Tramways Company.—The receipts for week ending May 5th, 1899, were £628 1s. 4d.; aggregate receipts for 18 weeks, £11,095 5s. 2d.; week ending May 6th, 1898, £577 7s. 1d.; aggregate receipts for 18 weeks, £10,661 1s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

Dulness has characterised the electric lighting market during the week, and there is a disposition amongst investors to hold their hands from operating in this department pending some definite decision upon the Corporation of London and the Vestries questions. The idea that the Charing Cross and Strand Company will "get into the City," to which we alluded last week, steadily gains ground, and in a market little anxious to buy electric shares, the quiet demand for Charing Cross is distinctly a feature. Hardly any quotable change, however, is to be observed in the prices, Citys to-night leaving off 17½, Charing Cross 11¼, and Metropolitans 17.

Among the lower-priced shares there has been more activity. Nernst Electrics have advanced to ¼ discount, which means a rise of nearly 5s. on the week. A daily contemporary, which quoted them at ¼ *premium* on Monday, is surely a little premature, but the market is inclined to talk the shares to par. Some of the weak holders, underwriters among the number, have now disposed of their shares; a more healthy tone is apparent. A large block of Aron Meter shares has also been finally disposed of, and, as this line for some time past has been hanging over the market like a very sword of Damocles, its removal is signalised by a rise in the price to ⅞ for both Ordinary and Preference. Wireless Telegraphy are 6½—7.

Manufacturing companies' shares are more in favour than those of the lighting class, and there is some demand for the industrial concerns; Henley's Telegraph Works have risen ½ to 25, and the Preference are a fraction harder at 19 buyers. Callender's Cable Construction have added ¼ to their price and now stand at 13, while Telegraph Construction and Maintenance at 38 are 2 better than a week ago. There is a demand for London Electric Supply Preference at 6⅝, and Crompton and Co. are up ¼ to 3⅝.

But "it is another story," as Kipling says, when we come to the telegraph shares. However greatly the new Pacific line will be appreciated by our colonies, its advent has excited suspicion and disgust in the mind of the telegraph shareholder, who now sees his Eastern stock down to 158, a drop of 5½ points in seven days. Eastern Extensions have not suffered at 16¼, the company's agreement with the Government being considered sufficient to ensure its coming out on the right side. West India and Panama shares, after standing for weeks at 5½, have lost the fraction, despite a good dividend announcement, and Anglo-American Ordinary relapsed 1 to 61½, although the Deferred has maintained its price. West Coast of America Telegraph shares are unaffected by the meeting of last Tuesday, when it was stated that the £34 net profit made by the company in 1897 had been augmented by £239 as the net result of the trading in 1898. Certainly this insignificant profit is better than the loss which provoked an undignified and acrimonious discussion at the Brockie-Pell Arc Lamp meeting on the previous day. The price of Brockie-Pells is still about 4s. 6d.

Strong buying of Central London shares by people credited with good information as a rule has sufficed to raise both classes of shares to the extent of 10s., and the respective quotations for the fully and the partly paid are now 10¾ and 8⅞. Stock Exchange talk anticipates the opening of the line at the end of October. Nothing is doing in either of the other electric railway companies, and British Electric Traction at 19 mark no alteration.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, May 3rd.	Closing Quotation, May 10th.	Business done during week ended May 10th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	60 — 63	61	60
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	110½—111½	110½—111½	111⅝	110¼
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	12¼— 12¾	12¼— 12¾	12 13/16	12½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15¼— 15¾	15¼— 15¾	15¾	15½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —195	185 —195	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	106	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10 xd	9 — 10	9 1/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	18 9/16	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	106 —109%	106 —109%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	...	11 — 11¼	11 — 11½	11¼	11 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6¼ %	7 %	...	161 —166	156 —161	164	156
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	101 —104	100 —104	101¼	101
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	100 —103	101 —104	102	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	121 —125 xd	119 —123	120	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16 — 16½	16 — 16½	16½	16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	100 —104	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	123 —127	121 —125	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102—105%xd	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11¼— 12 xd	11¼— 12	11 15/16	11 1/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16 xd	15½— 16	15 13/16	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 32	30½— 31½	30¾	...
92,600	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	57 — 60	57 — 60	58⅝	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	108 —111	108 —111	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	4½— 5	4½— 5	4⅝	4½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	11⅝	11
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	4 13/16	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	99½	99¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1 xd	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	127 —132	132½	127½
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	4 13/16	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	2 — 2¼	2 — 2¼	2⅛	2
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10⅜— 11¼	10⅜— 11¼	10⅞	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	11 — 12	11¾	11⅜
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8¼	7 15/16
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	17 — 18	17 — 18	17⅞	17⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15½	15⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	124 —129	124 —129	128	127⅜
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11¼	11⅛
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8½— 9½	8½— 9½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¼— 3⅜	3¼— 3⅜	...	...
45,...	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6¾	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —108	106 —108	108½	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16½— 17½	16⅞	16¾
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	12½— 13	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16½— 17½	16½— 17½	17	16 9/16
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	17 — 18	17 — 18	17¾	17½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3¼— 3½	3¼— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½— 15½	15½	15

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation May 3rd.	Closing Quotation May 10th.	Business done during week ended May 10th, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	3 — 3½	3 1/16	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18½— 19½	18½— 19½	19¼	18⅞
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	14 — 14½	14½	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —127	126 —129	128½	127¾
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	2 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼— 2½	2¼— 2½	2⅜	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	103	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	...	12½— 13	12⅜— 13¼	12⅞	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10½— 11	10 1/16	10½
178,303	Do. do. do. £8 paid	10	...	...	...	8 — 8½	8½— 9	8⅝	8⅜
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 4	3½— 3⅝	3⅞	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	5¼— 5⅜	5 1/16	4 15/16
630,000*l*	City and South London Railway	Stock	1 1/16%	1⅛%	2⅛%	68 — 70	68 — 70	69	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 3⅜	3¼— 3⅜	3⅜	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 — 101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2 — 2½	2 — 2½	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	96 — 98	96 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2¼	2 3/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105⅝	105¼
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅛— ⅜	⅝— ⅞	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	½— ¾	¾— 1	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24 — 25	24½— 25½	25¼	25
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜%	3½%	3¼%	10 — 10⅛	9⅛ — 9⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14⅜— 14⅝	14⅜— 14⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	35 — 39	36	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¾— 10¼	9½— 10	9⅛	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	108 —111	108	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10½—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜—½.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 16.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, May 10th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 10	£26 10	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a „ Recovered .. .. per ton	£5 15	£5 15	..
a „ Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£8	£8	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £130	£65 to £130	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£80	£80	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£80	£80	..
g „ Rod .. .. .. per ton	£80	£80	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/3	4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	54/10½	54/3	7½d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£10	£9 15	5s. inc.
g Lead, English Ingot .. .. per ton	£14 12 6	£14 12 6	..
g „ „ Sheet .. .. per ton	£15 10 0	£15 10	..
i Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£115	£115	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Flax, 6 or 8 lea... .. per lb.	4d.	4d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£34 10	£2 dec.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31 10	£31 10	..

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

"Capacity Measurements of Long Submarine Cables." By J. Elton Young, Member. Read April 27th, 1899.

(*Concluded from page* 744.)

In fig. 3, then, the influence of the leakage during the period of charging is approximately proportional to the insulation resistances B, *r*, which alter the potentials of the battery poles (A, D) by amounts dependent on the parallel resistances $\frac{a\,B}{a+B}$ and $\frac{b\,r}{b+r}$. This effect is independent of the time of charge since, by hypothesis, B and *r* stand for the true leakage resistances, and the apparent change of the D.R.'s of cable and condensers with time is treated as absorption. The potential of the junction (B) between the cable and condensers does not change, this point being connected to earth. The ratio of the capacities thus becomes

$$\frac{a\,B}{a+B} : \frac{b\,r}{b+r}$$

instead of $a : b$. This is approximate, because, on a long cable, the distribution of the leakage along the line somewhat modifies the problem.*

Another point to be noticed here is that the slide resistance *a*, *b*, must themselves be well insulated, since they commonly consist of 100,000ω, so that a leak of 10 megohms on the higher branch would mean, were the ratio of the arms, say, 4 : 1,

$$\frac{80,000}{20,000} : \frac{79,365}{20,000} : : 4 : 3\,9682,$$

nearly 1 per cent. error.

In fig. 4, B is insulated during charging. Its potential therefore alters with time under the operation of leakage, producing a positive variation through B and a negative one through *r*; thus we have an error proportional to the time of charge, unless the leakages be balanced. Corrections of Gott's test for this error have been tried in the following ways:—

1. By Dr. Muirhead's method, already referred to, of earthing the condenser (*f*) immediately after balance, and then measuring the difference from zero of the potential at B. This, although correct under certain conditions, has proved quite unreliable on a very long cable of unknown I.C.

2. By compensating the cable leakage exactly by adjusting the insulation resistance of the condensers so that $f\,B = F\,r$, B and *r* having been previously measured.† This is a very satisfactory plan when capable of employment, either *f* or B being varied as most convenient.

3. By calculation of the loss of charge during the interval between battery contact and balance. An analysis of the problem by Mr. E. C. Rimington was published in 1887,‡ but the formula arrived at does not appear to be what is wanted. A formula for the purpose was published by Mr. H. W. Ansell and myself in 1890§, taking into account leakage on the cable side only. Although it was evident that the error on the condenser side could be eliminated by a similar calculation so long as it acted alone, yet when both branches leaked simultaneously the problem did not appear to admit of a simple suggestion. Recently, however, Mr. Walter J. Murphy suggested to me taking the difference of the two errors, computed separately, which on trial I find yields practically exact results, at least in dealing with large capacities, such as those of long cables. The formula is then as follows:—

Let B, *r* be the *true* insulation resistances in megohms of the capacities *f*, F microfarads, and let *t* be the time of charge in seconds. Let

$$\log. k = \frac{\cdot 4343\,t}{f\,B}, \text{ and } \log. K = \frac{\cdot 4343\,t}{F\,r}.$$

Then

$$\text{True I.C.} = \text{Apparent I.C.} \times \frac{k}{K}.$$

This is the system of leakage correction applied to the results in Table I. Appendix. Experiments with shunted capacities of only 10 microfarads or less showed a slight departure from the rule.

Having indicated the *calculated* allowances for dielectric leakage to be made in the Thomson and Gott balances, I now come to what seems to be a more satisfactory mode of exact I.C. measurement than either of them, as regards correction not only for leakage but also for difference of rates of absorption. Being merely a modification of Lord Kelvin's original method, it has been termed the "modified Thomson" test. It appears to have occurred to more than one investigator, but to my friend, Mr. W. J. Murphy, belongs the credit of having proved its superiority as the most practical means of arriving at uniform results on long ocean cables, without the necessity for calculations; and my own experience has lately confirmed this conclusion.

In this method both leakages and absorptions are balanced *by observation and adjustment* during charging, absorption in *this* case being treated as apparent improvement of D.R. That is to say, the condensers are shunted by a resistance which is adjusted till it approximately balances the *apparent* D.R. of the cable at any time of charge. The connections for charging are those of Gott's method (fig. 4), with this important difference, that the key k_2 is closed during the charge. The effect of this is to keep the potential of the point B constant, as in the Thomson balance, while at the same time the deflection on the galvanometer shows whether or not there is a balance of (apparent) insulation resistances in the bridge system.

Since this balance is required to be such that $\frac{B}{r} = \frac{F}{f}$ it must be observed when $\frac{a}{b} = \frac{F}{f}$ nearly; that is to say, we must commence with an approximately correct position of the slider C. Then B, the leakage shunt across the condensers, is adjusted till G shows a resistance balance, as nearly as possible, at the end of any desired time of charging. For this purpose a set of plumbago resistances is useful, or it can be done roughly by the application of a pocket-handkerchief across the terminals of the condenser more or less closely as required; but it is preferable to estimate approximately the proper resistance and to arrange it beforehand.

Having thus charged, and balanced the apparent D.R.'s by observation, the test proceeds in the same way as the Thomson, viz., by short-circuiting and mixing the charges, and observing if any outstanding quantity remains on earthing the junction of the two capacities through the galvanometer. An additional advantage over the original Thomson balance is that there is no serious vitiation of results by battery leakage. Moreover, it admits of allowance being made for "cable current" by false zero observation, a most important point on long submarine lines. It should be remarked that in the modified, as in the original, method the *mixing* period must be sufficiently prolonged to discharge the cable, or variable results will ensue. On a section of 1,850 nauts I have found 15 seconds' mixing sufficiently long, within the limits of appreciation, even after a full minute's charging—*i.e.*, there was no difference between a 15 and a 25 seconds' mixing interval.

By means of a measurement thus carried out, it is possible to arrive at the same result for all times of charge, and any values of the dielectric resistance, and to dispense with all calculated allowances for leakage. Thus the desired uniformity of results is ensured, taking the constant value of the balancing condensers, determined by Dr. Muirhead's method, as a basis. With this value the latter should be marked, as well as with the temperature at which it was measured. Care must then be taken to correct the condensers for their temperature changes, by means of the coefficients furnished by Dr. Muirhead. It only remains to determine the very small coefficient of temperature variation applicable to the specific I.C. of gutta-percha. I have attempted to deduce this from the series of careful tests of two long cables appended to this paper, and arrived at a coefficient closely corresponding to that for paraffin; but Dr. Muirhead thinks it must be smaller than that. The search for such a minute residual phenomenon, where so many sources of error exists, must necessarily be elusive, in common with determinations of residual quantities in other departments of exact measurement.

In conclusion, since it may be asked of what practical utility are these researches after the exact I.C. of long submarine cables, their possible importance in connection with repairing operations may be alluded to. It must be remembered that on ocean cables a microfarad means some 3 nautical miles; so that a mistake in measurement of 1 per cent. in the distance to a sealed break, on a section of, say, 700 microfarads—if for any reason localisation from the other end were impracticable, as sometimes happens—would amount to an error of 20 nauts, and would not satisfy the standard of modern practice.

Table I.—Gott Method, Corrected for Leakage by Calculation.

Mean Temperature of Cables in every case, 5° Cent.

Condensers, 147·2 ϕ. D.R., about 20 Ω. Temp., 29·4° C.

I.C. by factory data at 24° C. Cable A. 596·5 ϕ					I.C. by factory data at 24° C. Cable B. 724·8 ϕ				
Time of charge.	Appt. D.R.	Appt. I.C.	$\log. \frac{k}{K}$	Corr. I.C.	Time of charge.	Appt. D.R.	Appt. I.C.	$\log. \frac{k}{K}$	Corr. I.C.
	Ω	ϕ		ϕ		Ω	ϕ		ϕ
5″	..	583·4	−·00193	580·8	5″	..	721·3	+·00014	721·55
10	..	600·5	−·00387	595·2	10	..	725·4	+·00029	725·9
15	0·5	606·2	−·00580	598·2	15	1·0	729·05	+·00043	729·8
30	0·98	618·0	−·01161	601·7	30	2·0	733·3	+·00087	7·348
45	1·10	631·4	−·01741	606·6	45	2·36	736·5	+·00130	738·7
60	1·20	638·0	−·02322	604·8	60	2·7	741·2*	+·00174	744·2*
300″	1·40=value taken for corr'cts				300″	5·0=value taken from corr'cts			

* Approximate.

* Taking this into consideration, Schwendler gives the following formula:—Multiply the apparent I.C. arrived at, by the ratio $\frac{l}{\lambda}$, where l = length of line in miles,

$$\lambda = \frac{1 - \frac{1}{K}}{m}$$

$$\log. K = m\,l \times 0\,43\,13,$$

and

$$m = \sqrt{\frac{r}{i}},$$

r and *i* being the conduction and insulation per mile, both in ohms.

† See the *Electrician*, February 5th, 1892.

‡ The *Electrician*, December 12th, 1890.

§ *Philosophical Magazine*, September, 1887.

TABLE II.—THOMSON METHOD, CORRECTED FOR LEAKAGE BY CALCULATION OR BALANCE.

Condensers, 146·3 ϕ. D.R, about 20 Ω. Temp., about 25° C.

I.C. by factory data at 24° C. Cable A. 596·5 ϕ					I.C. by factory data at 24° C. Cable B. 724·8 ϕ				
Time of charge.	Time of mix'g	True D.R.	Appt. I.C.	Corr. I.C.	Time of charge	Time of mix'g	True D.R.	Appt. I.C.	Corrected I.C.
		Ω	ϕ	ϕ			Ω		
30″	15″	1·0	577·8	589·6	30″	15″	20	727	No correction required, as leakage almost entirely absorptions.
45	15	..	586·0	598	40	20	..	731	
60	15 & 25	..	594·6	604·1	60	20	..	735·2	
120	20	..	about same		180	30	..	742·8	
180″	30″	..	about same		300″	35″	..	745·9	

TABLE III.—MODIFIED THOMSON METHOD. ABSORPTIONS AND LEAKAGES BALANCED BY OBSERVATION, APPROXIMATELY.

Condensers, 119·25 ϕ. D.R, 140 Ω. Temp., 24·4° C.

I.C. from factory data at 24° C. Cable A. 597·5 ϕ.					I.C. from factory data at 24° C. Cable B. 724·8 ϕ.				
Time of charge.	Time of mixing.	Appt. D.R. of cable.	Leak on condensers.	Constant I.C.	Time of charge.	Time of mixing.	Appt. D.R. of cable.	Leak on condensers.	Constant I.C.
		Ω	Ω	ϕ		Ω	Ω	Ω	ϕ
15″	10″	0·3	2·3	599·1	15″	10″	0·92	6	741·8
30	15	0·60	3·3	599·1	15″	10	0·92	12	too large
45	20	0·62	3·3	601·3	30″	15	1·7	12	741·8
60″	25″	0·63	3·3	601·3	60″	20″	2·5	51	about same

APPENDIX.

ON A STANDARD TIME OF CHARGE FOR ELECTRICAL MEASUREMENT OF LONG SUBMARINE CABLES.

To ensure the greatest possible accuracy and uniformity of measurement, it is desirable to fix some definite time of charge in observing the C.R. and the I.C. of a long cable, as well as for the D.R. test. In the last of the three measurements, 1, 2 or more minutes have been adopted according to requirements, but for the other two no such standard is generally recognised. It has been proposed (*vide* Darby & Fisher's "Submarine Cable Testing") to fix a period of $\frac{K B}{10^6}$ seconds, where K is the I.C. in microfarads, B the C.R. in ohms of the cable under test. This, however, is too short a charge; for, referring to fig. 1, it is evident that the steady state is not sufficiently approached. The value $\frac{K B}{10^6}$ of the line from which this diagram was derived is 3·75 seconds. Its C.R. when observed at 30 seconds was 5,155·5 ohms, but when observed at 10 seconds was 5,152 ohms, and would have been considerably less at 3·75 seconds; whilst above 30 seconds no rise of apparent C.R. was appreciable. Since absorption becomes thus approximately negligible after an interval of 30 seconds, this would appear to be a suitable period of charge to adopt in C.R. measurements, affording as it does convenient time to adjust the bridge balance. If seeking the C.R. of an *insulated* loop of two very long cables, 60 seconds might be advisable; but this is much better done by earthing the junction of the lines, when the time of charge of the loop becomes sensibly the same as for a single cable.

Moreover, on a long cable the observed C.R. not only requires time to become steady, but also needs correction for leakage. This again involves the selection of a definite value of the D.R. for the purpose. Thus it will not do to correct the apparent C.R. of a very long cable observed at 10″ by its apparent D.R. at 10″ charge, since the usual formulæ for distributed leakage are not applicable after so short an interval. On the other hand the 5th minute D.R. is somewhat too great, but its value at 80″ charge yields a closely correct result. Hence 30″ seems to be the proper standard time for D.R. observations taken for the purpose of correcting the apparent C.R.'s at 30″.

As regards I.C. measurements, although it has been shown in the foregoing paper that the "modified Thomson" method yields a constant I.C. value for all times of charge, yet a 30″ charge would be a very suitable one to fix for such observations, because the balancing condenser shunt can then be calculated for the standard 30″ D.R.; and its final adjustment can be conveniently made during this interval without undue hurry. If any other method of I.C. measurement be employed, a definite time of charging becomes necessary for purposes of uniformity.

Salamander.—In our notice of the Building Trades Exhibition last week we omitted to mention that the United Asbestos Co., Ltd., are among the exhibitors. We noticed an excellent variety of designs of their Salamander decorations for walls, ceilings, &c., which are absolutely uninflammable. The company have issued an 1899 supplement to their catalogue of this speciality.

CAPACITY OF LONG SUBMARINE CABLES.

IN the course of the discussion on Mr. Elton Young's paper at the Institution of Electrical Engineers, the following remarks were contributed by Mr. Walter J. Murphy:—

Mr. Young's paper will, I hope, prove to be a milestone on the road of progress towards a satisfactory method of obtaining the capacity of long submarine cables. It is a problem which has, I think, bothered most of those who have had to tackle it. At the outset of my career it certainly produced a feeling of despair, and a hopelessness of ever being able to qualify as an efficient electrician in that respect, because it seemed to me that I could obtain any value I chose for a cable, by slight variations in the manipulation of the test, and I could find nothing to guide me as to which of the results I obtained was the correct one.

Perhaps I had better point out shortly the difference between the usual Gott method of taking the test, and that which Mr. Young has finally found to be the best, and advocates in his paper. Gott's method took the place of the original Thomson method because, by placing the earth at the end of the slides instead of at the index, the effect of battery leakage was done away with, or at least greatly diminished. But though leading to an improvement in this respect, Mr. Gott's plan unfortunately introduced a cause of greater disturbance; because it is evident that, when the condenser and cable are joined in cascade, the cable only receives a charge from the battery during the instant the condenser is being charged.

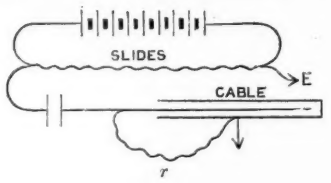


FIG. 1.

Immediately afterwards the battery further charges up the condenser through the high resistance of the dielectric, and the cable is simultaneously gradually *discharged* through the same high resistance (represented diagrammatically in fig. 1 by *r*).

If sufficient time is given the condenser will, in fact, take up practically the full potential of the battery; while, on the other hand, the cable will be reduced to the P.D. existing between the ends of *r*.

This is mainly the process which requires that the slider should be moved further and further towards the earthed end of the slides, as the time of so-called charge is prolonged.

It is about nine years now since I first realised that, if a connection is established between the index or slider and the point of junction of the condenser and cable (the index being placed somewhere near the position necessary to produce a balance), the action which I have just explained is prevented, and the condenser and cable have the potentials, necessary to charge them with equal quantities, impressed upon them. This idea gradually grew, and was eventually

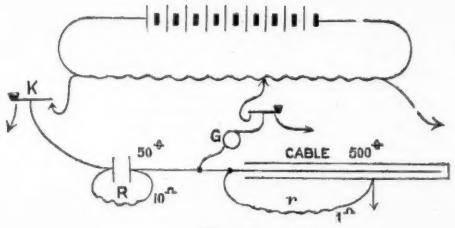


FIG. 2.

communicated to Mr. Young, who suggested that we should collaborate in writing this paper. But a difference of opinion upon an essential point, and the fact that we could not easily communicate with each other, eventually decided him to write the paper alone, and leave slight differences between us to be decided by the discussion, or by future experiment.

Mr. Young has, since his return to India, tried the method* I suggested to him, and finds it does away with the difficulty which arises from the action I have just described, and practically annuls the necessity of making any correction to the Gott test.

Another way of accomplishing the same end is to join a resistance (fig. 2) across the condenser which is inversely proportioned to the capacities of the condenser and cable, and to the dielectric resistance of the latter. Thus if the cable has a capacity of 500^{ϕ}, and a dielectric resistance of 1^{Ω}, while the condenser is of 50^{ϕ}, then a resistance of 10^{Ω} would be placed across the latter.

The resistances B and *r* then assist to impress the proper potential differences upon their respective capacities.

The manipulation consists in watching by means of the galvanometer, G, placed in the index circuit, for the moment when, through the gradual rise of the dielectric resistance *r*, B and *r* are balanced

* First published in the *Electrician* of November 5th, 1898.

(the index having previously been placed at a point which it is expected will give a capacity balance). When this occurs the charge in c and C are mixed by earthing K, and the accuracy of the adjustment of the index tested by ascertaining if they completely neutralise each other.

Another advantage which arises from placing the resistances across the condenser is that the effect of the earth or cable current is thereby compensated for, since it is evident from fig. 3 that the E.C. will then be impressed upon each capacity in a proper proportion.

Mr. Young refers to the effect of temperature upon the electrostatic capacity of cables. I took an opportunity which offered a few

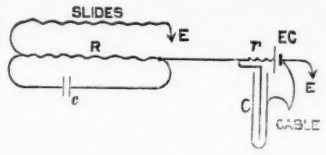


FIG. 3.

months ago, to ascertain if pressure or temperature really affected the true capacity of a cable. This was during the laying of 150 nauts of cable into a depth of some 1,000 to 1,100 fathoms of water, which meant changing the temperature of the cable from 83° F. to about 37° F., and increasing the pressure from one atmosphere to nearly 20.

Careful tests were made for several days by the method advocated, while the cable was in the ship's tanks and at the higher temperature, and repeated while the cable was being laid out, and again after it had been down for some time, and had therefore settled down to the lower temperature, and greatly increased in dielectric resistance in consequence. No change in its true capacity could be detected. I consequently conclude that if temperature affects the apparent capacity of a cable at all, it is due to the influence it has on the absorption and upon the D.R. and not upon the true capacity of the cable.

THE ELECTRIC LIGHTING OF FULHAM.

On Wednesday night in last week the Fulham Vestry discussed at considerable length the question of the tenders for the supply of mains, machinery, plant, &c. The report of the Lighting, Electric Lighting and Dust Destructor Committee contained the following paragraph which was moved by Mr. T. GREEN, the chairman of the Committee:—

c. We have very carefully considered the reference to us with regard to the tenders received for the supply of mains, machinery, plant, &c., and a letter from the General Electric Company, Limited, stating that although they had made an error of £1,000 in the sum quoted in their tender for river pipes (as mentioned in their letter to the Vestry dated April 13th, 1899), they were prepared to carry out the whole of the contract in accordance with their original tender, and at the prices set forth therein. We *recommend* that the lowest tender, viz., the General Electric Company, Limited, for the sum of £45,718 7s. 10d., be accepted for the entire works; that the solicitor to the Vestry be instructed to prepare the necessary contract in accordance with the terms and conditions of the specification approved by the Vestry, and that it shall be a condition of the contract that all work shall be carried out in the United Kingdom.

Mr. SAYER moved that the report be referred back to the Committee for further consideration, and in doing so said that it appeared that the report was decided upon at a sub-committee meeting held the previous Friday night. The meeting was called for 5 o'clock, and their electrical adviser previously received a letter from the clerk informing him that the meeting had been postponed for half an hour. As a matter of fact, the meeting was not postponed, and, presumably, the idea of informing the electrical adviser that it had been postponed was to allow a communication being made to the Committee in his absence. He would have taken no action in that matter were it not for other facts that had come to his knowledge. It had come to his knowledge that letters had passed between Mr. Green, the chairman of the Committee, and Mr. Medhurst, the electrical engineer, and it appeared to him that the report of the Committee was all cut and dried before the engineer came to the meeting.

The CHAIRMAN (Mr. Drew) asked Mr. Sayer whether it was wise to go into the question of letters which had passed between the electrical engineer and the chairman of the Committee, but

Mr. SAYER considered that he would be quite right in doing so.

At this point a stranger in the public gallery intervened in the debate in support of Mr. Sayer, and a division was taken on the question of his being asked to withdraw.

The incident terminated in an amusing manner, for while the division was being taken the stranger politely wished the Vestry "Good night!"

Mr. SAYER proceeded with his argument to refer the matter back, and pointed out that Mr. Green wrote to the electrical engineer stating that unless the contract was given to the lowest tenderer he would resign his position and retire from public life in Fulham. He (Mr. Sayer) looked upon that as an attempt to influence a public official. He was surprised that Mr. Green had so strongly supported the General Electric Company, because previously he had strongly supported the electrical adviser's report that the contract should be split up. In a few days, however, there was an entire change of front on the part of Mr. Green. In view of the letters he had referred to, he did not see how they could possibly accept the tender of the General Electric Company that night.

Mr. OAKEY seconded the amendment to refer the matter back, and on a division there was a tie—17 either way.

The CHAIRMAN gave a casting vote against the amendment.

Mr. SAYER then proceeded to move that the tender of the British Insulated Company for the mains be accepted. Theirs was the lowest tender for this item, viz., £14,152 18s. 6d., and he contended that if the tender for that part of the work was accepted, it would lead to a saving of £650 to the parish. The company stood at the top of the tree, and was as good a firm as they could possibly get to carry the work out.

This was also seconded by Mr. OAKEY.

Mr. EASON asked if the electrical adviser had any objection to the amendment.

Mr. MEDHURST said he had no objection whatever.

Mr. AVERN said that if they took a profitable item for the contract, they could not expect the General Electric Company to carry out the remainder, especially as it included an item which obviously would show a loss of £1,000. Even, however, if they did accept the proposition of Mr. Sayer, and saved the £650, they would lose £1,500 or £1,800 on the rest of the contract if it were not carried out by the General Electric Company. Every member of the Committee had made up his mind as to the tender before he entered the room at the Committee meeting, and so far from the majority joining the chairman, it was the chairman who joined the majority.

Mr. LEE pointed out that the General Electric Company themselves had sub-contracts, and it would be cheaper for the Vestry to give the work to those contractors who were specialists in their own particular lines. They themselves were amateurs, and the ratepayers paid handsomely for the advice of an expert, and they would be in a peculiar position presently if they accepted the tender against the advice of their expert adviser, who would have to superintend the work.

Mr. EWOODS contended that it was the Vestry who was responsible for the undertaking, and if they were not to exercise their own discretion and judgment it was no good having a vestry.

After considerable discussion, both for and against the recommendation of the Committee,

Mr. MEDHURST (electrical engineer) said that his contention was that there was favouritism being shown in that particular matter He had a letter from the Vestry clerk, stating that the meeting was to be postponed, but it was not postponed. It was quite possible that statements had to be made which could not be made at a public meeting, but they could have been made in his presence. He appealed to their reason if the true intention was not that his knowledge being necessarily greater than that of the members of the Committee, he was not allowed to be present, as he might have been able to contradict the statements made. The only conclusion that could possibly appeal to their intelligence was that there was something behind the letters he received from the chairman of the Committee and the clerk. There seemed to have been a desire to influence the Committee, if not behind his back, at any rate not in his presence. He considered that it was a proof that kissing had gone by favour to a very marked extent, and he asked them not to obtain an exceedingly unenviable notoriety by confirming the action of the Committee. It was a painful position to have to speak against the report of the Committee, and he had rather he had never been connected with the work than have to do it. He asked them to pause before accepting that recommendation, which was being thrust down their throats in an exceedingly improper way.

Mr. CRANFIELD asked if Mr. Medhurst, as technical adviser, said they should not accept the tender?

Mr. MEDHURST said he did say so most emphatically.

Mr. CRANFIELD said that Mr. Medhurst gave them no reason for so advising them, and he should not vote at all. It appeared to him that they were being treated as schoolboys.

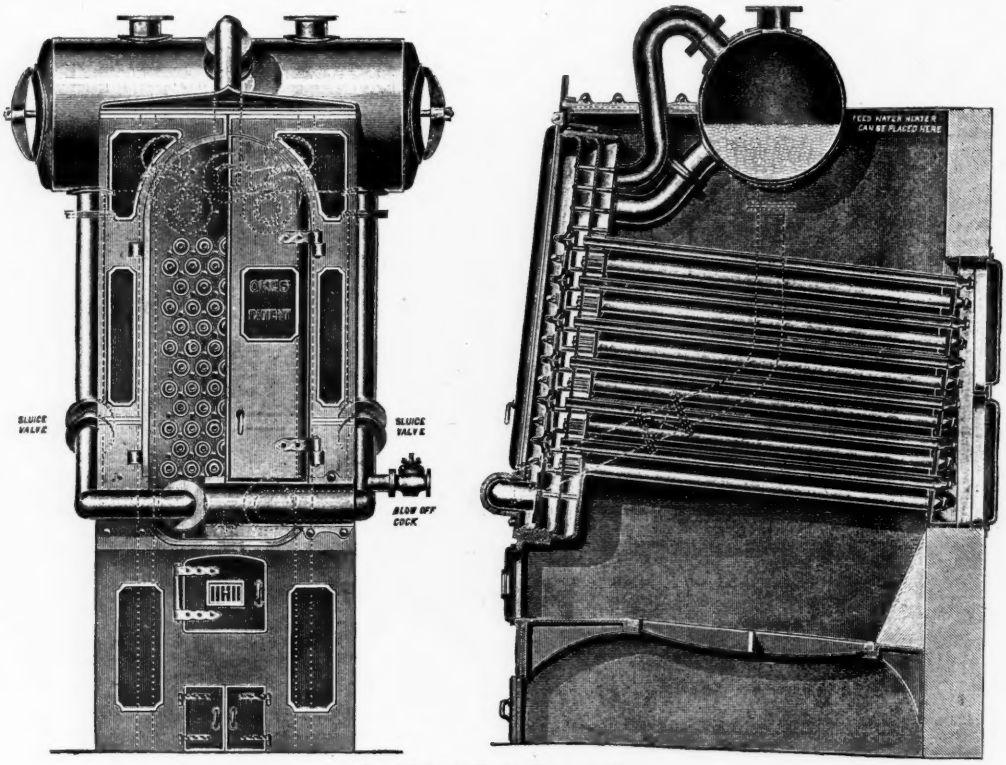
After further discussion it was agreed to adjourn the debate till the following Wednesday, and that in the meantime the sub-committee should meet again.

THE OKES-SERVE WATER-TUBE BOILER.

We gave a brief description of this boiler some months ago (see ELECTRICAL REVIEW, March 10th), and referred to one or two points in which it was claimed to possess advantages. We are now able to illustrate the boiler, from which it will be seen that it is one of the growing class of water-tube constructions with tubes closed at one end and fitted with internal circulation tubes, the inner and outer tubes having their separate and independent headers, so that the circulation is more positive and less obstructed than when there is any opportunity for interference of the up and down currents. There are valves fitted by which, if desired, the up and down pipes may be closed for the purpose of reversing the circulation when blowing off. Considerable weight is attached to this feature by the makers, and it is a feature on which we could not comment favourably in our previous notice of this boiler. It is now pointed out that the sluice valves are not to be used at every blow off, but occasionally only, and that the danger we pointed out is to be safeguarded against by providing a lock and key, which latter is to be kept safe by the engineer. It is because of this very safeguard that we object to the system. We fully agree that the reversal of the circulation may have some good effect in clearing off sediment if frequently done. But it is not to be done frequently, and we still cannot speak other than unfavourably of such appliances as unnecessary complications, which ought not to find a place in a steam boiler, and which, we think, are not so valuable but that they might be spared. The header plates are outwardly flanged and stayed

by stud stays. The closed chamber formed by the three plates, the middle one or diaphragm plate being the one which carries the ends of the inner tubes, enables the water circulation to be forced by placing a pump in the circulation system, whereby injury to pipes by forced draught and rapid evaporation is avoided. The tubes are only 7 feet long, their diameter being 3½ inches. The length is thus 24 times the diameter, a ratio which experiment seems to have demonstrated as sufficient, for any greater length is considered by some engineers to afford a surface for heat absorption greater than the capacity of the tubes to circulate the water in sufficient quantity to prevent too rapid evolution of steam in one length of tube.

Each generating tube can be removed by simply taking off one nut, and removing the cover plate at the header. Joints are few in number, and the various stresses due to expansion are provided for by the single attachment of the tubes. The tube inclination is 1 in 10½, an angle probably sufficient where forced calculation is adopted; but we think a trifle flat unless this provision is made, and it is, we think, too flat for marine purposes. The steam drum is placed across the boiler, and from its lower part extend the two down-comer pipes to each end of the header chambers, the upper ends of the headers



Okes-Serve Water-Tube Boiler.

communicating with the steam drum by curved pipes, which enter the drum at a higher level. The advantages in the arrangement and construction of this water-tube boiler are the freedom from expansion stresses in the water tubes, the free escape of steam, rendered possible by the arrangement of the headers, general accessibility, simplicity of construction, portability, the various sections being of small weight, and lightness per H.P. Great weight is laid on the forced circulation, but we have no specific information as to how this is intended to be carried out, but it will be obvious to anyone that great assistance could be given to the circulatory flow in a steam boiler by placing a centrifugal pump in the course of the flow. Such a pump would absorb but little power, being simply called on to keep going a current of water against the frictional resistance alone of the circuit. It is a large boiler which will evaporate 600 gallons of water per hour, or 10 gallons per minute, but no very large pump will provide for the positive circulation of several times this amount, which would ensure that the tubes always contained an ample supply of water.

ESTABLISHMENT CHARGES IN ENGINEERING WORKS.

In finding the cost of manufacture in an engineering works, there are, says Mr. Cowen in a paper before the North-East Coast Institute of Engineers, three classes of costs:—(*a*) The direct cost of work; (*b*) the indirect cost, due to shop charges; and (*c*) the indirect costs, due to the establishment charges. It is easy to find the first, but classes (*b*) and (*c*) involve at all times uncertainties, and can only, at best, be approximated.

Direct charges include simply the cost of material and all labour directly expended upon the article in question.

Shop charges are made up of a proportion of foremen's wages and wages of general hands, of engine power, oil, waste, files, and other items which it is not possible to divide out with accuracy.

Establishment charges include rent and taxes, management, agencies, &c. Mr. Cowen submits a system of making up costs, and selects, to illustrate, the fitting and smiths' shops, the boiler yard, and the foundry. Assuming the boilers to be centralised, but under control of the fitting shop, and that they supply the engines of every department and of the hydraulic power pumps, their cost must be divided over all departments. In making up the cost of the boiler department he allows 7 per cent. depreciation and 3 per cent. wear and tear, water at its cost per 1,000 gallons, coal, and wages.

He then divides the charge in the proportion of the power supplied to each of the other departments. We do not see why he omits from the boiler costs the item of interest. He allows this in all other machinery and plant at 5 per cent.

Shop and establishment charges to make up the annual cost of running each machine are obtained by adding a percentage to the direct wages. This percentage varies from outside erecting at 30 per cent. of the wages to 100 per cent. on the cost of apprentices, and 120 per cent for smithy apprentices, as follows:—

	Per cent.
Fitters and labourers	65
Outside erecting	30
Apprentices	100
Smiths and strikers	85
Apprentices	120
Boiler smiths and labourers	75
Men at fires	85
Apprentices	100
Pattern makers	30
Apprentices	60

These percentages cover use of tools, and it does seem as simple a method as any to charge simply so much on direct wages. These wages, of course, are to be assumed on a basis of the shop being reasonably full of work. When fluctuations occur, the costs are, of course, greater on each item manufactured, but it would be entirely wrong, therefore, to increase the charges, for this would compel estimates and tenders to be abnormally high, and would still further empty the shop of work. Fluctuations, therefore, imply less or more profitable working. Foundry work of course can be charged simply a tonnage rate, but we think that a diagram of charges would show correctly a curved line, heavy castings being really debited with a less ton rate than light castings.

The paper is useful and suggestive, and may prove an aid to costing of work. No fixed rules can be laid down, for every place must stand by itself. No place, however, if new, can be apportioned out until it has run some time and an idea obtained of a fair basis. But an approximation can be made and corrected by experience. Many establishments have come to grief from lack of knowledge of establishment charges, and the proportion which these bear to output

should be watched carefully, for if they begin to unduly increase there is a leakage somewhere, which should be found out and checked.

ELECTRIC LOCOMOTIVES.

The paper read May 4th before the Institution of Electrical Engineers by Mr. McMahon was based on figures obtained over a period of two years on daily working of the City and South London Railway. Undoubtedly this railway affords a useful field for experimental tests, as it is run with locomotives, and it would be interesting to compare the results with those obtained on the same line from motor cars for the purpose of finding the retardation of curves. Mr. McMahon's first series of observations were on the effect of varying the starting current upon the acceleration.

It was shown that the amount of starting current had but little effect within fairly wide limits on the time taken to run a particular section or upon the total energy drawn from the line, the motor being of series type with plain series regulation. Each locomotive has two motors directly connected and in series. Regulation is by a reversing switch changing the armature connections, a simple rheostat and a main break switch.

In the first series of tests the starting current was limited to 100 amperes; in the second to 120; the third, 140; the fourth, 160; and the fifth, 180 amperes, starting from each station, and maintaining the currents steady until the back E.M.F. brought the current down. The velocities were respectively 13, 14, 14·5, 14 and 14·75 miles per hour, but the times taken in acquiring these speeds were 60, 50, 45, 40 and 45 seconds, the discrepancy at the higher speed being due to the back E.M.F. keeping the current down. It is thought that the fields might with advantage be weakened at starting or the motors so arranged as to maintain a larger drawbar pull up to the maximum speed. The total energy consumed per trip seems independent of the starting current. This is contrary to American experience, and seems to point to the sections and speed not being so well proportioned to secure economy as they might be. Rapid acceleration and free running beyond a given point seems to characterise American practice, and in the course of his tests the author was forced to the same conclusions, finding decided economy in so varying the dimensions and windings of the motor armatures as to give more rapid acceleration. On this point it is well to observe, as he does, that much depends on the length of the section of line to be worked and the permissible acceleration and deceleration, or, as the author prefers to term it, negative acceleration, ignoring the fact that deceleration is quite as legitimate a word as acceleration and not simply an Americanism. Surely a science which freely admits "booster" may tolerate deceleration.

The paper is far too voluminous to print *in extenso*, and is also somewhat difficult to abstract. Its earlier portion is rather a record of detailed tests somewhat foreign to the actual purpose of the paper and simply explanatory of the means employed to obtain certain of the figures, involving considerations of the lengths of cars with reference to their times for entering upon grades.

Sufficient to say that as regards tractive effort per ton of train, including air resistance, which of necessity must be somewhat abnormal in a narrow tube, every care seems to have been taken to secure accuracy, and upon a level a train of 37 tons at 15·86 miles per hour absorbed 10·95 lbs. per ton of a three-coach train. Beginning at zero of speed at nearly 40 lbs. per ton, the traction curve drops rapidly to 10 lbs. at nearly 6 miles velocity. It falls slightly below 10 lbs. from 6 to 13 miles speed, and rises thence almost as a straight line, until it attains 22 lbs. per ton at 26½ miles. The figures obtained were further analysed to discover the effect of curves. This was found difficult, owing to the shortness of the curves. As nearly as could be found, however, the resistance added by a curve of 390 feet radius was 15·15 lbs. per ton at 16·5 miles per hour, or considerably more than the traction per ton for straight and level track at the same speed. A curve of 540 feet radius showed an additional traction due to curvature at 13·5 miles per hour of 11·3 lbs. per ton, or exactly the same as the straight and level resistance at that speed. On each of these curves the guard rail no doubt adds something to the resistance. So far as the figures can be depended upon, being obtained from a rather limited range of possible observation, they are valuable in showing the importance of curvature. Speaking roughly, a curve doubles the resistance of a train when drawn by a locomotive, and it is on this point that much interest would attach to comparative tests of vehicles drawn by locomotives and self-propelling. In the one case the pull of the locomotive tends to pull the wheels of its train towards the inside rail of a curve.

In the case of self-propelled vehicles there is no such tendency. The natural tendency of a vehicle when running freely as we may assume for the present purpose they do, is to press towards the outer rail. In a locomotive-drawn train this tendency is counteracted by the pull of the locomotive, the rear of which is itself pulled inwards against the inner rail, while its leading wheel is forced against the outer rail. The net effect can scarcely be estimated, nor can it be said which method will be productive of the greatest resistance. Experiments are needed to determine this point. The chief interest of the paper lies in the comparison of the different locomotives used upon the line in regard to their starting, running, and general efficiencies and powers, and the effects of varying the length and winding of the armatures.

——	No. 12 locomotive.	No. 15 locomotive.	No. 17 locomotive.
Type of motor ...	2-pole Edison-Hopkinson.	2-pole Siemens	2-pole Edison-Hopkinson.
Magnet section ...	17 in. × 10 in.	24 in × 10 in.	20 in. × 10 in.
Weight of magnets complete with bearings.	40 cwt.	53 cwt.	44 cwt.
Type of armature...	Gramme ring.	Drum.	Gramme ring.
Diameter of core ...	17½ inches.	14⅜ in.	17½ in.
Number of turns ...	540	500	540
Cross section of conductor.	No. 10 = ·01286 sq. in.	·400 × ·078 = 0312 sq in.	01286 sq. in.
Segments in commutator.	54	125	54
Weight of arm with wheels complete.	19¾ cwt.	21 cwt.	22 cwt.
Armature resistance	·3 ohm.	·181 ohm.	·315 ohm.
Total resistance of locomotive.	·8 ohm.	·615 ohm.	·85 ohm.
Total weight ...	10 35 tons.	13·5 tons.	11·6 tons.

In order to make clear the references to these motors, we reproduce from the paper a few of their leading dimensions and data.

The tabulated data show that there is a difference for each locomotive between the time taken from starting until the locomotive comes to rest in the next station, and the actual time the locomotive is taking current. No 12 always took current for the least period, due to its average speed being higher. It also takes the highest average starting current and requires longer to get up speed than either No. 15 or 17, the latter, however, drawing a larger average starting current from the line than No. 15, and getting up to full speed more quickly. These figures seem to indicate a tractive effort per ampere at starting somewhat too low in the case of No. 12 and too high in the case of No. 15, that of No. 17 being a happy mean.

While high tractive pull per ampere is quite a correct feature, the current falls off so quickly as the speed increases that the effort at the tread of the wheel of No. 15 is soon reduced below that of Nos. 12 and 17, a difficulty which might be overcome by shunting the field at a speed of 10 miles. This, however, would be uneconomical, for the tractive effort per ampere would then be less by reason of the weaker field. Experiment proved this, the energy consumption being increased 50 to 75 per cent. Now, with No. 12 locomotive, though a larger current is taken during the running period, the time is shorter. Taking No. 15 locomotive as standard in respect of the consumption of energy, No. 17 shows a decrease on six sections of line of from 1·5 to 9 per cent, while No. 12 shows an increase in every section of 6 to 26 per cent., a difference which points to the winding of the motors being unsuitable for the work. It does not, however, point to inefficient motors, and it is noticeable that No. 12 is more economical on the longer sections and on the

up grades, so that were the sections longer and the period of acceleration bore a smaller relation to the total time than at present, the economy of No. 12 would probably surpass that of the other two, because No. 12 draws a higher current at the higher speed and gives a tractive effort at the tread to

EFFICIENCIES.

—	Acceleration.			Running.		
	At drawbar.	At tread.	C^2R loss.	At drawbar.	At tread.	C^2R losses.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
No. 12	29	52 35	23·5	73 4	86·4	12·5
„ 15	28 4	53·2	12·8	71 6	88·15	8 12
„ 17	30 5	57 7	20 0	69·85	86 25	10 2
„ 3	46 1	65 5	27 6	70 6	86 4	9 6

suit such speed. The average efficiencies of the three locomotives as well as No. 3, to which reference will be made in the sequel, are given as above for the periods of starting and running, the figures being averaged from the runs over the same sections of line.

The high C^2R loss of No. 12 is not to be counted necessarily as disadvantageous if only it can be reduced after the external resistance of the regulating switch has all been cut out. Taking the whole of the energy and losses which can be thus found, there appears to be accounted for 98 9 per cent. of the energy supplied to No. 12, while No. 15 returns 96·27 per cent., and No. 17 shows 96·5 per cent., leaving an average 3 per cent. to be accounted for. During acceleration No. 12 wastes on external regulating resistance 21·2 per cent. of the energy supplied to it, No. 15 wastes 31 per cent., and No. 17 19 3 per cent., these figures being the difference from 100 of the tread efficiency plus C^2R loss plus 3 per cent. for the probable greater friction of the locomotives and their greater air resistance, which were neglected in taking the tractive resistance of the engines as only that of a carriage.

The investigations having proceeded thus far, and the tractive force at the tread of the wheel being known, it was then determined to try if an improvement could not be effected upon No. 12 locomotive by winding the motors to give a higher tractive effort per ampere. This would solve the starting difficulty, and the series parallel control was decided upon for the running period, though with some reluctance, the existing switching arrangements having given such good results at very small cost of repairs. The windings were increased 50 per cent. to 810, giving 1,595 lbs. tractive force at the tread of a 27-inch wheel for 150 amperes, falling to 415 lbs. at 50 amperes. At 430 volts the speed was calculated to be 15·5 miles per hour with 150 amperes, and 22 75 miles with 50 amperes. For the series position and 215 volts the speeds were 5·5 at 150 amperes and 9 3 at 70 amperes.

Limiting the starting current to 150 amperes, the tractive force at the wheel tread is 3,280 lbs. for two motors, and it is calculated that in 21·5 seconds a distance of 129 7 feet will have been covered, and an 8 miles velocity attained. The motors can then be put into parallel with a current limited to 125 amperes per motor, or 250 for the two. It will begin to fall at a speed of 17 miles per hour, and it is prevented from exceeding the figure allowed by means of an external resistance. When a speed of 20 miles has been attained the distance covered is 1,258 feet, leaving 1,442 feet to be covered for a section of 2,700 feet in length. The author says that experience teaches that when a train is running at a speed of 20 miles per hour it can be brought to rest in 20 seconds without causing inconvenience to passengers. To do this with a constant decelerating force requires a distance of 292 feet.

Therefore, of the 1,442 feet left to travel there remains 1,150 feet to be covered at the maximum speed of 20 miles in a period of 39·4 seconds. The total journey time has been 130·3 seconds, including that required in accelerating to 20 miles' speed.

When the current in parallel working is limited to 70 amperes per motor, the time required to cover 2,700 feet is increased to 155 seconds, the energy absorbed being 2,200 watt-hours, of which only 1,679 were usefully employed. But if the motors will take 150 amperes in series working, why, it is asked, not allow 150 each in parallel working?

The chief objection to this is the strain on the generating station, but to obviate this possible objection the jump in current should be first to 200 amperes, then almost instantly to 300. In this case the journey time is shortened to 125 seconds and the energy consumption is reduced to 1,945 watt-hours, of which 1,736 are made useful, a much less ratio being now wasted in external resistance. Thus the time is reduced by 24 per cent. and the watt-hours of energy by 11·5 per cent. These figures confirm what has already long been recognised and pointed out in these columns, that high starting current, and therefore high acceleration, has a decided advantage, and it seemed that the number of conductors might be still further increased, and this was done, the new number being 972. With this winding a current of 150 amperes gives a tractive force of 2,000 lbs. at the wheel tread, which can be maintained at 215 volts up to four miles velocity, and at 430 volts up to 12·3 miles. At 50 amperes the pull is 540 lbs. up to 8·4 miles per hour at 215 volts, and up to 18·25 miles at 430 volts. Working out a performance diagram on these figures, but limiting the current in parallel to 140 amperes, the time to run 2,700 feet becomes 140 seconds; the energy in watt-hours is only 1,584, of which 1,420 are usefully employed, showing, as compared with the first motor under the same conditions and limits, a saving of 10·7 per cent. of time and 38·9 per cent. of energy, while further economy would attend a use of 300 amperes in parallel. The economy still increasing, a further calculation was made on the basis of 1,134 armature conductors, which reduced the wire section to the lowest desirable limit. This winding would give 2,300 lbs. traction at 150 amperes, and 670 lbs. at 50 amperes, the first being capable of being maintained up to a speed of 1·75 miles, the latter up to 6 miles at 215 volts, while at 430 volts the speeds become 9 and 14 miles. The time on the section is 145 seconds, but the watt-hours are only 1,410, and the maximum speed is 16·5 miles, while it was 20 miles for No. 1 motor and 19 for No. 2 motor. The following table gives some of the characteristics of the various windings:—

No.	Conductors.	Armature resistance.	Field resistance.	Total resistance.	—
		Ohms.	Ohms.	Ohms.	
No. 1	810	·45	·21	·66	...
No. 2	972	·618	·135	·75	...
No. 3	1,134	·856	·218	1 064	...
No. 4	810	·673	·123	·796	Armature 50 % longer

Thus No. 3, though economical, cannot run the section in the time required, viz., 130 seconds without the fields are weakened. They can be made to do it by first shunting the motor fields with a 50 per cent. shunt and then reducing the field further as speed increases. When shunted 50 and 66 6 per cent., the current rises from 145 amperes to 200. The second shunt comes in at 14 miles velocity, and the locomotive attains a speed of 21·5 miles before the current is shut off and brakes applied, and the section is run in 129·1 seconds at an expense of 1,780 watt-hours. Were No. 2 placed earlier in parallel, it would run the section in 129 seconds, at an expense of 1,770 watts.

It was next tried to lengthen the armature and magnet cores 50 per cent., and with this motor, No. 4, by using the 50 per cent. shunt at 16 miles per hour, the section was run

No.	2,700 feet section.		4,000 feet section.		5,280 feet section.	
	Time.	Energy.	Time.	Energy.	Time.	Energy.
1	130	1,905	173	2 372	211	2 760
2	133	1 700	179	2,160	221	2,660
3	130	1,780	170 3	2,360	210	2,910
4	126·6	1,625	170	2,150	208	2,660

in 126·6 seconds for 1,552 watt-hours of energy, and this motor was not merely the best for the 2,700 feet section, but also for sections of 4,000 and 5,280 feet, as shown by performance diagrams. The extended tables are very interesting. For the important length of 2,700 feet, No. 1 is clearly the

worst motor when both time and energy consumption are considered; but when longer sections are to be run, No. 3 runs No. 4 very closely in time but stands badly as to economy, while No. 2 comes very close in economy. After all this trial experimenting it must, we think, be very satisfactory to the makers of No. 1 as originally wound—the No. 12 locomotive—to find that its performance improves so much on the longer sections.

Assuming, however, that 2,700 feet is the ruling section, it remains to inquire into the best possible design for that purpose. If deceleration can be at the rate specified above, so should an equal acceleration be possible of 1·46 feet per second. Adopting this rate at each end of the section, and assuming 130 seconds to cover the section, a speed of 16·25 miles per hour must be run.

(To be continued.)

ELECTRICAL ENERGY PRODUCED DIRECTLY FROM CARBON.

By Dr. D. TOMMASI.

Mr. W. R Cooper in a paper read recently at the Institution of Junior Engineers, London, on batteries consuming carbon gave a description of a battery in which the soluble (negative) electrode instead of being composed of metal is formed of carbon dipping into salted or acidulated water, and he attributes the idea to Messrs. Case and Coehn. Now, this is not correct, for Messrs. Case and Coehn can only claim the merit of having had an idea which I had realised 15 years before.

In fact, a battery of this kind was presented by me in 1884 to the Académie des Sciences, Paris. This battery which was described as *a battery with carbon electrodes (without metal)* was, moreover, described more in detail in my "Traité des Piles Electriques," p. 308.

The following is a brief description of my battery (see figure):—In the centre of a cylindrical glass jar is a rod of carbon covered with a thick layer of peroxide of lead and enclosed in a bag (*a*). This electrode thus enveloped is placed in a perforated tube of carbon (*b*); the whole arrangement occupies the centre of the glass jar which is filled up with pieces of retort carbon (*c*) and half filled up with a concentrated solution of chloride of sodium with the addition of chloride of calcium (*d*), this latter being eminently hygrometric, preventing, or at least greatly retarding, the evaporation of the water. The fragments of carbon not submerged are covered with a layer of chloride of calcium.

This battery has an electromotive force of ·6 to ·7 volt, it only works on a closed circuit, but as it polarises rapidly it is only suited to applications that can be worked by an intermittent current.

The theory of this battery is as follows:—

According to thermic data a molecule of protoxide of lead passing into the state of peroxide gives off 12·14 calories.

The heat of formation of the anhydrous protoxide of lead (Pb O) being 51 calories, it follows that the heat of formation of the peroxide (Pb O^2) is 63·14 cal. Reasoning from the action exercised by carbon on water,* we can explain as follows what takes place in the jar of the battery.

The carbon decomposing the water on a closed circuit, carbonic acid would be formed and hydrogen would be given off, according to the equation

$$c + 2\,H^2O = CO^2 + 4\,H.$$

The thermic effects of this reaction are:

$$102{\cdot}6 \text{ cal.} - 138 \text{ cal.} = -\,35{\cdot}4 \text{ cal.}$$

On the other hand, in the bag which takes the place of the porous jar, there would be a reduction of the peroxide of lead, and formation of water according to the equation:

$$Pb\,O^2 + 4\,H = Pb + 2\,H^2O$$

and the thermic effects of this reaction would be

$$138 \text{ cal.} - 63{\cdot}14 \text{ cal} = 74{\cdot}86 \text{ cal.}$$

The heat resulting from these two reactions is the algebraic sum of their thermic effects, or

$$74{\cdot}86 \text{ cal.} - 35{\cdot}40 \text{ cal} = 39{\cdot}46 \text{ cal.}$$

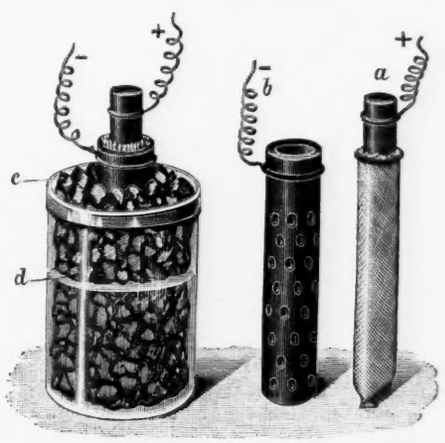
The volt corresponds, according to certain writers, to 46·3 cal. The electromotive force of the battery with carbon electrodes would be

$$\frac{39{\cdot}46}{46{\cdot}30} = {\cdot}85 \text{ volt.}$$

If we assume for the volt the value 47·16 cal. adopted by other writers we get

$$\frac{39{\cdot}46}{47{\cdot}16} = {\cdot}84 \text{ volt.}$$

Direct measurements have given ·6 to ·7 volt. This difference is easily explained when we consider that the battery is easily polarised, and that besides carbonic acid, oxide of carbon is formed (70 per cent. of CO^2 and 30 per cent. of CO) which would tend to lessen the heat produced by the first reaction. In fact, if we calculate the electromotive force of the battery with carbon electrodes according to these data, we find that it is equal to ·7 volt, and that this value is to all intents the same as that found by experiment (·6 to ·7 volt). According to some electricians the giving off of electricity in my battery would be solely due to the chemical action exercised by the solution of chloride of sodium which



serves as electrolyte on the peroxide of lead (Pb O^2) which surrounds one only of the two carbons that constitute the electrodes of the battery. As to the other carbon (the one not covered with peroxide of lead) it would not be attacked by the solution of chloride of sodium in a closed circuit, and therefore it would act merely as an electrical conductor. Now, this theory is inadmissible, for it is contrary to experience.

In fact:—1. In all voltaic couples in which a solution of chloride of sodium is used as electrolyte, it is always the water that is decomposed and never the chloride of sodium. Peroxide of lead (Pb.O^2) exercises no chemical action on even a concentrated solution of chloride of sodium. These reservations being made, let us assume for a moment that this theory is true, *i.e.*, that the giving off of electricity in the carbon battery is due exclusively to the action of the chloride of sodium on the peroxide of lead *, but on this hypothesis, it would be the carbon covered with peroxide of lead that should constitute the negative electrode since it is the seat of a chemical action, whereas the other carbon, which, according to this same theory is not attacked, should form the positive electrode of the battery. Now, exactly the contrary is the case, since it is the carbon covered with peroxide of lead that constitutes the positive pole and the carbon without Pb O^2 that forms the negative pole, *i.e.*, the soluble electrode of the battery.

This is what also takes place in the following couple:

* D. Tommasi, "Electrolysis of Water with Electrodes of Various Natures." (*Comptes Rendus de l'Académie des Sciences*, Paris, 1881.)

* This supposition is inadmissible, for neither free chlorine nor the oxygenated compounds of chlorine that might be generated in the decomposition of the chloride of sodium, have any influence on peroxide of lead.

— carbon, acidulated water; porous jar filled with oxide of copper + carbon.

In this couple the oxide of copper is reduced to the metallic state. Now this reduction could not take place if the water was not decomposed by the carbon with the formation of carbonic acid and oxide of carbon, whereas the hydrogen set at liberty would be carried towards the positive pole of the battery and would reduce the oxide of copper.

$$Cu\,O + 2\,H = H^2\,O + Cu.$$

It cannot be doubted that the carbon is attacked by the oxygen resulting from the decomposition of the water.

In short, recent experiments have confirmed what I had already demonstrated some years ago, viz., that when we electrolyse acidulated water using a carbon anode, the latter is attacked with the formation of carbonic acid and oxide of carbon*

Why, then, should it be thought strange that the carbon in a voltaic couple cannot act as a soluble electrode.

ELECTRICAL RADIATION.

By J. E. TAYLOR.

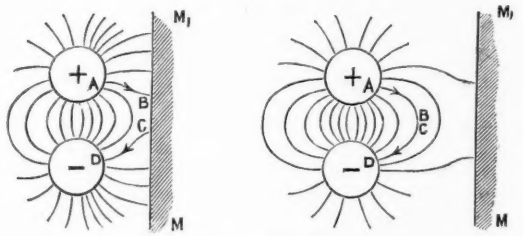
There is undoubtedly an element of mystery abroad in the minds of the generality of electricians as to what constitutes electrical radiation. Some, and among them are many well-known scientists, are content to believe that electrical radiation and electro-magnetic induction, or even electrostatic induction, are one and the same thing. Others even go so far as to implicitly deny the very existence of such radiation, and set at nought the whole series of brilliant researches by Hertz and others in this connection.

It was thought when Hertz's researches were made public that Maxwell's electro-magnetic theory of light had received what amounted to an experimental confirmation, and that the experiments of Faraday showing an interaction between light and electrical, or magnetic effects, were being robbed of some of their mystery. Was there any substantial foundation for so believing?

The work of Hertz still lives, nor are his theories moribund, only our electricians are not yet taught on such lines as enable them to see sufficiently deeply into the elementary facts of electrical action, more especially the facts of electrostatics. They will possess clearer conceptions of electrical radiation when they are educated on revised lines and given theories which more accurately fit the facts. They are taught about quantities of a mysterious entity called "electricity," which resides only on the surfaces of bodies and distributes itself in inexplicable ways over their surfaces, and which is still on the surface if the conductor be turned inside out, &c. The idea of lines of force is only a secondary consideration, a sort of conception which it is convenient to apply when all other methods fail. The main and essential point of dielectric polarisation or strain, is, if not disregarded, looked at askance as though it were merely some effect produced by the "electricity" on the charged body rather than what it in reality is—the cause of the surface effects on the charged body. It is very doubtful whether the term "electricity" may not be altogether excluded from use in connection with the teaching of the subject. It is always misleading for the simple reason that, as Prof. Rowland has put it, it does not, as an entity, exist. In all his papers Hertz carefully avoids the term.

Let us, then, treat lines of force, whether electric or magnetic, as something much more real and tangible than has been the custom. They are more real than many suppose, and although it is not possible, in one short article, to go into details of elementary methods of treatment from the lines of force point of view, yet it is hoped that by their aid a clearer meaning may be conveyed as to the nature of electric radiation.

As the aim of this article is to, if possible, throw a little more light on the mystery of so-called "wireless telegraphy," it may be as well to clear the atmosphere a little as regards whether radiation has anything to do with the results achieved by Marconi in this direction or not. It has been suggested that the effect is one of ordinary everyday electro-magnetic induction or of simple electrostatic induction. In every case both electro-magnetic and electrostatic inductions are what may be called "volume effects," and if the generator and detector be sufficiently far removed from one another in comparison with their dimensions, the law of the inverse cube of the distance comes into play. This means that the intensity of the effect diminishes with great rapidity when the distance is large, and there cannot be much doubt that Marconi's results are not due to either cause. Each would be immensely too feeble over the distances concerned. On the other hand, radiation not being a volume effect, but a "shell effect," so to speak, never diminishes more rapidly than the inverse square of the distance if generated in free space, and there is no good reason for doubting that this is the active effect concerned. It can even be made to diminish in intensity less rapidly than the distance, as is the case with short waves and parabolic reflectors, and also with waves transmitted along conductors. Hertz's experiments have been spoken of as merely electro-magnetic induction effects following the ordinary laws of such induction, and the writer has even seen it stated that Hertz himself said so. The whole tenour of Hertz's papers deny the statement. If this were so, what then becomes of Clerk Maxwell's electro-magnetic theory of light, seeing that the fundamental laws of electro-magnetic induction and of luminous radiation differ at the start? The intensity of the luminous radiation emitted from a point is inversely proportional to the square of the distance. That is to say, the whole radiation emitted from the source during a given period of time travels bodily outwards as an expanding shell, and is independent of that source after once being



Figs. 1 and 2.

emitted. It travels on independently of what may be behind, or of whether the source has ceased to give light. A thousand years hence, provided that there is no obstacle in the way, it is still travelling on its outward journey. With electro-magnetic induction effects, the field of force simply expands as a whole, but as a whole it does not propagate itself. It simply distributes itself through the volume of space surrounding the source. Destroy the source and the whole field is destroyed, nothing travels out. Again, light is capable of parallel transmission, a beam of luminous radiation can be projected from a parabolic mirror. This beam can be refracted, polarised, and produces shadows of opaque substances in its path. Where is the analogy in electro-magnetic induction? All these effects can, however, be produced with electrical radiation as distinct from induction. The idea of electrical radiation being a mysterious X ray kind of effect, emanating from an electric spark, also exists in the minds of many. This is not established on fact, and needs no refutation.

Previous to Faraday's time electrical and magnetic effects were not associated in any way with the surrounding medium. A quantity of imponderable invisible electric fluid was supposed to have the power of producing effects at a distance without any intermediate action. Faraday showed that the intervening dielectric was all-important, and introduced the conceptions of dielectric polarisations and lines of force. Maxwell, Poynting, Hertz and others, gave still more real meanings to these lines of force, whether magnetic or electric, and we, as a rule, still have to grasp their full import. Poynting showed how the transfer of energy in an electric circuit was effected through the dielectric surrounding the

* See the "Traité d'Electrochemie," by D. Tommasi, p. 513.

conductor, and Hertz demonstrated how dielectric effects, both magnetic and electric, could be made independent of conductors; that is, how they could be made to exist in free space without the presence of conductors. The existence of these forces, combined, in space without the presence of conductors, constitutes electrical radiation.

In order that an electric field may exist independent of any conductors, it is necessary that the lines of electric force, or polarisation, or, as they may, perhaps, be preferably called, lines of strain, be made "self-closed." Magnetic lines always are self-closed. Electric lines are generally supposed only to exist with both ends terminated on conductors. Now, as a matter of fact, electric lines of strain can be cut up or subdivided, and joined together again, and stretched out like elastic threads or allowed to contract and shorten themselves indefinitely. In reality all these effects take place in any ordinary influence machine or even in the simple electrophorus. The multiplying or "doubling" process depends upon some at any rate of these actions taking place.*

Let us consider one of the simplest cases of a line of strain being cut in two and then joined up again. In fig. 1 we have an electric field of strain existing between two conducting spheres. A metallic sheet, M M_1, is brought near the spheres on one side. This causes a redistribution of the field. Some of the lines run direct from one sphere to the other, and others from the spheres to the metallic sheet. One line, A B C D, has just divided itself into two portions, A B and C D. In fig. 2 the metallic sheet, M M_1, has been withdrawn to a sufficient distance to cause some of the lines to re-unite and run direct between the two spheres. The two portions of the line, A B C D, have so united at the ends, B and C, and as the metallic sheet is further withdrawn, the ends of other lines glide together over the surface of the sheet, and, when the two ends meet, re-unite to form single continuous lines. If by any means we can cause the ends, A and D, of the line, A B C D, to likewise meet together they also should join, and would then form a self-closed line which would exist in the dielectric independent of what happened to the conducting spheres. This is exactly what does take place in the Hertzian radiator. Generally speaking, it always happens if an electric circuit of any kind is set into sufficiently rapid electric oscillation compared with the dimensions of the circuit. To a very limited extent it happens in the case of an oscillatory Leyden jar discharge, but the rapidity of oscillation even in this case is not nearly quick enough to produce anything like powerful radiation and effects such as Prof. Lodge's syntonic reactions between Leyden jars tuned to oscillate at the same rate, although commonly spoken of as effects of radiation, cannot properly be so termed. The effect, as Prof. Lodge himself has pointed out, is one of electro-magnetic induction, and does not take place over great distances with moderate dimensions of circuits. It may be well here to point out that there are cases where dielectric strain exists in the shape of self-closed lines without actual radiation occurring; but these are somewhat exceptional, and the conditions for radiation, viz., that the electric and magnetic energies present in free space are equal in amount, do not hold. One case is that of an ordinary helix or solenoid, round which a current is flowing. Here the magnetic lines thread through the solenoid, and their distribution is such, that both inside and outside the solenoid the associated electric field must be in the shape of closed circles, otherwise the invariable law that the electric lines are at right angles to the magnetic, and both at right angles to the direction of propagation of the fields would not hold. And, in fact, the circular electrostatic field can, in this instance, be made visible by the device of winding a few turns of insulated wire round a bulb exhausted of air to such a point, that it is in about its most sensitive condition electrically. If, then, a suitable highly charged Leyden jar be discharged through the coil, a luminous circle is seen in the bulb. This luminous circle is doubtless the result of a sufficiently intense electric field being generated in the bulb to break down the weak dielectric of exhausted air. It is an interesting point of theory, and due to J. J. Thomson, that even then the self-closed lines are not destroyed, but merely split up into an immense number of smaller circles of molecular dimensions. In fact, a line of electric force is never destroyed. The energy associated with it is, to a large extent, abstracted, no doubt, but the line itself merely breaks up into self-closed circles of molecular dimensions.

(*To be continued.*)

* See Electrical Review, 1892, "A Study of the Influence Machine."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

8,510. "Improved method of running electric telegraph or telephone wires or pipes of any kind." W. R. Meikle. Dated April 24th.

8,515. "An improved accumulator for the storage of power." J. Rowley. Dated April 24th.

8,522. "Improvements in and relating to storage batteries." R. Welford. Dated April 24th.

8,564. "Improvements in combined joint or services boxes and fuse boxes for concentric and other electric cables." A. J. Lawson, J. G. Childs, and J. D. Dallas. Dated April 24th. (*Complete.*)

8,565. "Improvements in electric brakes." G. H. B. Hooper. Dated April 24th. (*Complete.*)

8,570. "Combined electric light reflector and advertising tablet for the interior of shop windows and like positions."

8,605. "An improved portable electric rivetting machine." F. S. Dudgeon. (F. von Kodolitsch, Austria-Hungary.) Dated April 25th.

8,629 "Improvements in wireless telegraphy." S. G. Brown. Dated April 25th.

8,641. "Improvements in apparatus for rectifying alternating electric currents." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated April 25th. (*Complete.*)

8,651. "New or improved safety appliances for overhead and other electric conductors." J. Unsworth. Dated April 25th.

8,672. "Improvements in and relating to electric motor carriages or vehicles." A. Lewis. Dated April 25th.

8,693. "Improvements in converting transformers." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite, France.) Dated April 25th.

8,726. "Improvements in switches for electrical purposes." A. Watson. Dated April 26th.

8,762. "Improvements in desks and registers for attachment to telephones." P. R. J. Willis. (H. F. Forrest, Canada.) Dated April 26th.

8,775. "Improvements in and relating to electric incandescent lamp fitttings." M. Lachman. Dated April 26th.

8,820. "Improvements in electrical signals or indicators." A. W. Staveley and I. H. Parsons. Dated April 27th. (*Complete.*)

8,840. "Improvements in incandescent electric lighting systems." The British Thomson-Houston Company, Limited. (A. G. Davis, United States.) Dated April 27th. (*Complete.*)

8,857. "A new or improved quicksilver electric current interrupter." G. Hirschmann. Dated April 27th. (*Complete.*)

8,873. "Improvements in lighting trains by electricity." C. P. Elieson and W. S. Naylor. Dated April 27th.

8,887. "Improvements in electric traction." W. B. Day. Dated April 28th.

8,913. "Improvements in cut-outs, fuse boxes, and analogous electrical fittings and other electrical purposes." R. F. Hall. Dated April 28th.

8,934. "Improvements in and relating to Röntgen ray apparatus." J. M. Davidson. Dated April 28th.

8,949. "Improved starting mechanism for electric motors." R. Belfield. (T. S. Perkins, United States.) Dated April 28th.

8,957. "Improvements in or connected with connecting devices for electric conductors." H. Reason and The Mutual Electric Trust, Limited. Dated April 28th.

8,961. "Method of and apparatus for effecting the storing up of speech or signals by magnetically influencing magnetisable bodies." V. Poulsen. Dated April 28th.

8,963. "Improvements in the production of a filling paste or active material for the plates of secondary batteries." C. F. P. Stendebach and H. M. F. Reitz. Dated April 28th. (*Complete.*)

8,975. "A safeguard against screw loosening on electric incandescent lamp shade-holders." W. Schloesser (holder of the firm "Kammgarnspinnerei Eitorf") and H. Moeres. Dated April 29th.

8,990. "An improved contact breaker for induction coils." H. W. Cox. Dated April 29th.

8,991. "An improved table for X ray examinations of patients." H. W. Cox. Dated April 29th.

8,995. "Improvements in or connected with electrolytic means and apparatus for converting metals and metallic ores into oxides or other like compounds." T. G. Hodgson and E. Bailey. Dated April 29th.

9,010. "Electrical door opener." J. Futterknecht. Dated April 29th.

ELECTRICAL PATENTS OF 1885 EXPIRING IN MAY, 1899.

We are informed by W. P. Thompson & Co. that about 90 applications for electrical patents were filed in May, 1885; of these some were never completed, and of those that were only one has been allowed to run its full term, viz, 14 years, and being of considerable interest we give a short abstract of it below:—

5,828. "Improvements in the mode of vulcanising the insulating covering of electrical conductors." B. J. B. Mills. (J. J. C. Smith, United States.) Dated May 12th, 1885. Relates to the vulcanisation of insulating coverings on the conductor. The insulating coverings is enveloped in a coat of tin-foil or other malleable metal. The conductor is then wound on a large light drum in two or three layers and the whole is put into the vulcaniser and submitted to heat and pressure. The drum is rotated on a horizontal axis during vulcanisation. 3 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free*, 9*d.* (*in stamps*).

1897.

2,301. "Improvements relating to time meters for telephonic conversations." H. Keim. Dated January 28th, 1897. A time indicator is provided with a pair of wheels having pins projecting inwardly from their faces. The pins on one wheel correspond to, say, intervals of three minutes and on the other wheel to intervals of five minutes. The tripping lever of a striking mechanism can be set by lever to engage with one or other of the wheels, the position being shown by pointer. A cord for moving the dial hand back to its initial position, at the same time rewinding the clock. 2 claims.

2,953. "Improvements in or connected with conduits for electric railways and tramways." W. Cope. Dated February 4th, 1897. Relates to electric railways and tramways on the conduit system. The channel is built up of slot rails, and a lower part in one or two sections of stoneware, iron, &c., or it may be built of brick or concrete. Two conduiting rails are held by the insulators with sloping tops and weeping holes to throw water towards the drains. A grooved wheel running on the conductor carries two brushes or rubbers counterbalanced to bear on the two conductors. 3 claims.

3,973. "Improvements in arc lamps." I. H. Hegner. Dated February 13th, 1897. Mechanical feeding apparatus of any kind is controlled by two independent devices, feeding being allowed only when these act simultaneously. In the form illustrated, a wheel is held by two brakes. One is applied by a series coil and is withdrawn when the main current falls below the desired strength; the other is withdrawn by a shunt or differential coil when the difference of potential of the carbons exceeds a desired amount. Applications of the invention to clutch-lamps and other lamps are mentioned. It is stated that the lamps are suitable for working three in series on 100-volt supply mains. A former Specification, No. 24,375, A.D. 1895, is referred to. 3 claims.

4,461. "Improvements in connection with brushes and their holders for dynamos." W. M. Mordey. Dated February 18th, 1897. Relates to dynamo-electric machines, brushes and brush-holders. A dynamo brush is made up of a number of carbon plates, separated from each other throughout the greater portion of their length by insulating material, but electrically connected together at their outer ends, either by the insertion of metal strips, or by forming them integral with each other at that end. In mounting the brush in its holder, a strip of insulating material is inserted on the forward side, so as to cause the current to pass into the brush mainly by the rear plates and thus reduce sparking. When the machine is required to run in either direction, connection is made with the middle of the brush. Instead of using carbon plates alone, a combination of carbon and metal plates may be employed. 4 claims.

4,487. "Improvements in and connected with electric arc lamps." E. Buchholtz and P. Spies. Dated February 19th, 1897. Relates to improvements in arc lamps. A clutch lamp is constructed, the moving parts and the arc being separately enclosed. The upper carbon is loose in a tube, which can slide vertically, to some extent, in a closed cylindrical casing, when a core carried by the tube is attracted into a series coil surrounding the casing. The tube carries a boss with inclined holes containing balls; when the tube is raised, these are lifted from the bottom of the casing, and grip and lift the upper carbon. The balls may be replaced by sliding wedges, or by pivoted grippers; the latter are disengaged from the carbon by fixed inclines when they descend. The movements of the tube are braked by an inclined slot in it engaging a screw on the base. Balls are pressed against the upper carbon by springs carried on the tube to make electrical connection. The carbon is also guided by a cap and balls in the tube. A series resistance coil is wound on a porcelain ring, and is covered by a ventilated outer case. The lower carbon may be held by helical springs placed in a circularly grooved block, or by balls in inclined holes. The arc is enclosed in a globe, the open top of which is held air-tight against packing on the base by a helical spring in a channel around the base engaging below a rim on the globe. 7 claims.

4,916. "Improvements in electric accumulators." E. Heyl. Dated February 23rd, 1897. The positive electrodes of lead accumulators are prepared from lead wool pressed into plates of a porous character and converted into peroxide by charging. To preserve the plate from disintegration the lead wool or the finished plate is dipped into a solution of India-rubber, &c., containing chromate of lead or like salt suspended in it. After drying, the rubber is vulcanised by the wet chloride of sulphur, or other process, and the plate is then exposed to the action of an electric current to render the rubber coating porous by dissolving out the lead chromate, or a suitable solvent may be employed. An alternative process is to heat the plate and evaporate the solvent, the escaping gases giving the rubber a spongy texture. The electrodes are perforated to allow of expansion. Pasted grids may be protected in a similar way, the rubber coating being first applied to the grid and again to the pasted plate. A thin perforated rubber coating may be used to cover wires or strips to be built up into plates. Small tubes may be used in place of wires, cores of vulcanised rubber preserving them from disintegration. 6 claims.

6,398. "Improvements in electricity meters." G. Hookham. Dated March 11th, 1897. Relates to energy meters. In order to definitely stop the armature of a motor meter when the main current is stopped, an iron arc or extended piece, such as a piece of fine wire, is fixed on the armature so as to pass under a stationary magnet. The effect of the acceleration caused by the approach of the iron to the magnet ceases before the iron passes the magnet. In the arrangement illustrated, the magnet is a screw carried by a clamp on a brake magnet. 1 claim.

6,778. "Improvements in electric current-conducting apparatus for electric railways with underground feed." C. F. P. Stendebach and O. H. Linker. Dated March 15th, 1897. Relates to road contact systems, with or without a conduit, in which the switches are operated mechanically. *Conductors, switches, collectors, permanent way.*—The switch is contained in a box which may also act as a support for the rails. The lower contact is connected to the conductor, and the upper one is carried inside the bell-shaped cover, which is depressed against a spring by the collector. A mercury seal for this cover is arranged, and a roller on its top forms a bearing surface for the collector. This long collector is made in sections hinged, &c., together, so as to round curves, and carries a continuous cable with conducting extensions embedded in insulating material. In a modified form, the switch is placed at the side, and is operated through a push and lever, whilst another lever throws out a contact to touch the conducting surface of the collector. Another form, placed in the road between the rails, is also shown. A treadle depressed by the wheels, &c., lifts the stud, which is electrically and mechanically connected to the contact, and throws in the bolt to hold it raised. When the second wheel of the vehicle depresses the treadle the bolt is withdrawn and the stud, &c., falls. These actions are performed by the lever pivoted on the end of the lever worked by the treadle and arranged so that it acts under the shoulder and alternately on each side of the bolt lever. In a modification the depressions of the treadle alternately raise and lower an eccentric segment which carries a rubbing surface for the collector, and also acts on a switch similar to those described. 5 claims.

6,787. "Improvements in electric telegraphic systems." W. L. Wise. (A. C. Crehore and G. O. Squier, U.S.) Dated March 15th, 1897. Signals are sent by stopping individual impulses of a rapidly pulsating current, preferably a sinusoidal alternating current sent to line from an ordinary alternator. The signals to be sent are perforated in tape, and this is fed at the proper rate between two brushes or a brush and wheel, by a wheel geared to the alternator or a synchronous motor; the tape may be provided with feeding perforations. The brushes are in series with the alternator and line, and are adjusted so that, with continuously-perforated paper, successive half waves of current pass through successive perforations, the intervening parts of the paper breaking contact between the brushes at times when little or no current is passing. Symbols, represented by unperforated parts of the paper, are thus represented by omissions of one or two successive half waves of current on the line. Otherwise, the symbols may be represented by perforations and impulses sent, and spaces by the absence of these. The signals are received by an electro-chemical, photographic, or other recorder. Transformers may be placed between the transmitter or one or more receivers and the line. A photographic recorder is illustrated in which light from a diaphragm passes crossed polarising prisms, only when a current is passing in a coil surrounding an intervening medium, and is focussed on travelling sensitive tape; this is drawn from a reel through developing and fixing baths in a dark chamber. 9 claims.

10,051. "Improvements in or connected with holders for incandescent electric lamps." L. Masson. Dated April 22nd, 1897. Relates to holders for incandescent lamps. A porcelain case is made in two parts, which are put together before the porcelain is fired, to enclose a disc loosely. The case is provided with bayonet slots for the pins of a capped lamp, and with a screw-threaded metal nozzle. The disc is of porcelain and carries two connecting plates, each provided with a spring plunger, and a binding screw accessible through a hole in the case. The disc being loose the case can be screwed on a support without twisting the wires. The disc may be fixed by inserting a pin through the case, or by using a screw large enough to engage the case. 3 claims.